Final Archaeological Excavations at The Brennan Site (7NC-F-61A), State Route 896, New Castle County, Delaware

By

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Department of Anthropology
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Delaware Department of Transportation Archaeology Series No. 116

Eugene E. Abbott
Director of Planning

1994

Delaware
Department of Transportation

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Federal Highway Administration

FINAL ARCHAEOLOGICAL EXCAVATIONS AT

THE BRENNAN SITE (7NC-F-61A), STATE ROUTE 896,

NEW CASTLE COUNTY, DELAWARE

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ABSTRACT

The Brennan Site (7NC-F-61A) is a small prehistoric archaeological site where jasper, from nearby outcrops of the Delaware Chalcedony Complex, was reduced to produce a variety of different stone tools. Phase III data recovery excavations were undertaken at the site to collect data on stone tool production activities. Diagnostic artifacts from earlier Phase II excavations indicate that the site was occupied during the Woodland I Period (ca. 3000 B.C. - A.D. 1000). Flake attribute analysis of a random sample of jasper debitage from the Brennan Site showed that primary jasper bifaces and cores almost exclusively served the lithic needs of the site's inhabitants. Although a semi-sedentary settlement system appears to have been present in northern Delaware during the Woodland I Period, and though such systems have been associated with an emphasis on core technology, evidence from the Brennan artifact assemblage suggests that biface technology played an important role in the curated tool kits of the Brennan Site's occupants. The site was probably occupied by prehistoric people who were returning to distant base camps after a visit to the Delaware Chalcedony Complex quarries.

<u>Cover Illustration</u>: Air view of the Brennan Site excavations in relation to existing Route 896 and right-of-way of the new road. Iron Hill, a major source of the stone materials used by the site's prehistoric inhabitants, is located eight kilometers north of the site along Route 896.

DelDOT Archaeological Series Index Information

This form is intended to provide information on the contents of this volume for indexing. It is also intended for researchers to use to check the research methods and topics included in this volume.

Report Title: **FINAL ARCHAEOLOGICAL EXCAVATIONS AT THE BRENNAN SITE (7NC-F-61A), STATE ROUTE 896, NEW CASTLE COUNTY, DELAWARE**

DelDOT Report Number: **116**

Level of Investigations: [Phase I, II, III, Planning Survey, Specialized Study]

PHASE III

Basic Time Periods Covered:

__X__ All prehistoric
_____ Mainly prehistoric, some historic
_____ Equal coverage of prehistoric and historic
_____ Mainly historic, some prehistoric
_____ All historic

Site Contexts:

	Prehistoric	Historic
Plow zone/disturbed surface soils	X	
Intact features	X	
Buried artifact-bearing strata	X	

List up to five major time periods or site types

1. **WOODLAND I PERIOD (3000 BC - AD 1000)**
2. **TRANSIENT PROCUREMENT SITE**
3. **SECONDARY LITHIC REDUCTION SITE**

List up to eight major topics covered in Conclusions and Discussions of Results

1. **REGIONAL LITHIC TECHNOLOGIES**
2. **LITHIC RESOURCE USE PATTERNS FOR NORTHWESTERN DELAWARE**
3. **FLAKE ATTRIBUTE ANALYSIS**
4. **REGIONAL SETTLEMENT PATTERNS**

Specialized Analyses Undertaken

	Prehistoric	Historic
Blood Residue	X	
Ceramic Chronology		
Ceramic Vessel Surface Alterations		
Cordage Twists from Ceramic Impressions		
Faunal Analysis		
Flake Attributes	X	
Floral Analysis	X	
Flotation	X	
Geomorphology and Pedology		
Glass Analysis		
HABS Documentation		
HAER Documentation		
Historic Architecture		
Informant Interviews		
Leather Analysis		
Miller Ceramic Index		
Mortar Analysis		
Palynology		
Projectile Point Chronology	X	
Projectile Point Function	X	
Radiocarbon Dates		
Soil Chemistry		
Spatial Distribution of Artifacts	X	
Stone Tool Functional Analysis	X	
Wood Identification		

List up to 5 other specialized analyses not listed above:

NOT APPLICABLE

Geographic Area Covered:

__X__ New Castle County
_____ Kent County
_____ Sussex County
_____ All State

ACKNOWLEDGEMENTS

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Curation Note: All artifacts, site records, analytical data, photographs, slides, and video tapes from the Brennan Site are curated at the University of Delaware Center for Archaeological Research, Newark, DE 19716. For further information contact Jay F. Custer, University of Delaware (302-831-2821) or Kevin Cunningham, Delaware Department of Transportation (302-739-3826).

Brennan Site Crew Members

From left to right: Dan Bailey, Scott Watson, Terry Middleton, Rich Heisler, and Matt Wise.

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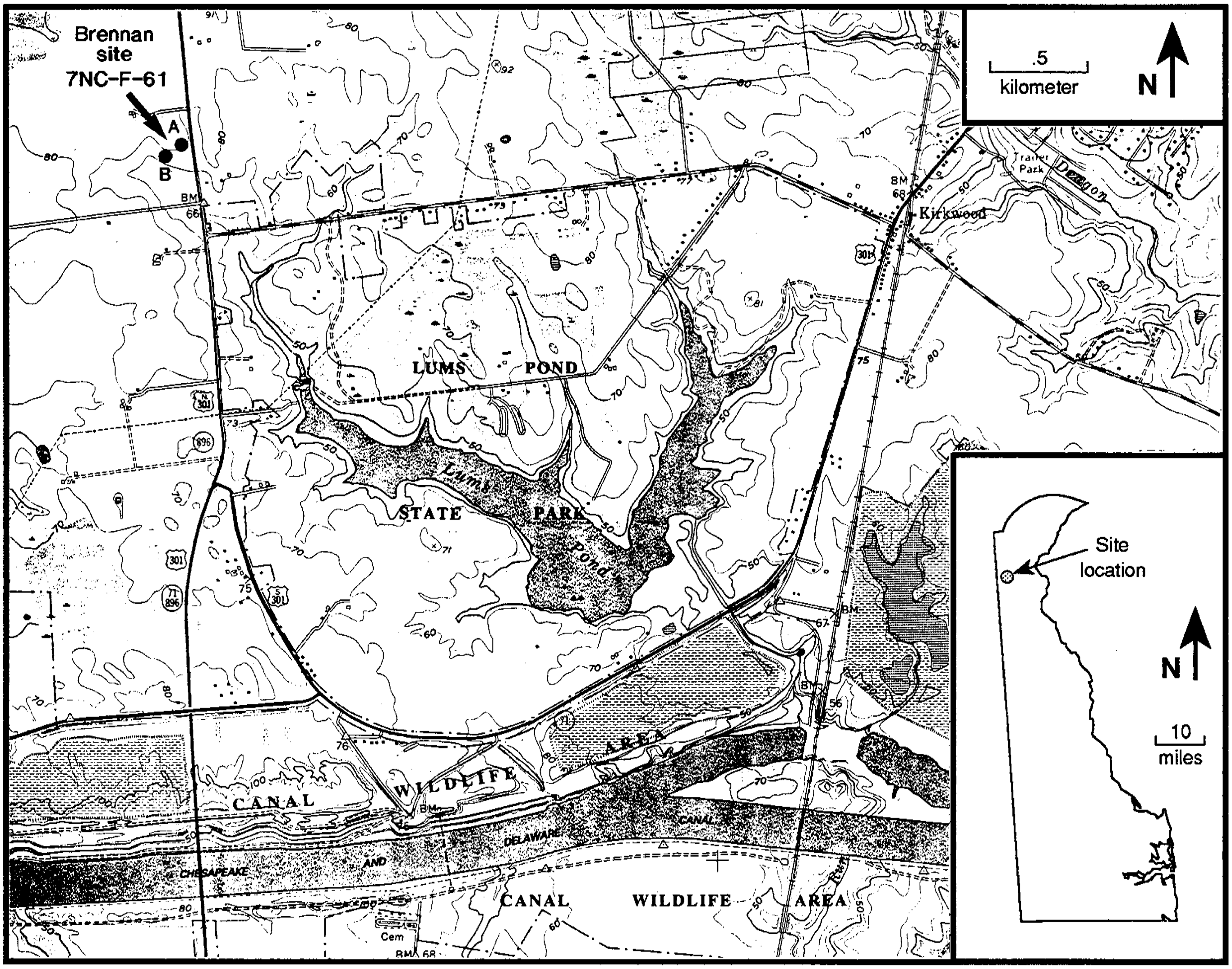


INTRODUCTION

The purpose of this report is to describe the results of Phase III data recovery excavations at the Brennan Site (7NC-F-61A) in southwestern New Castle County, Delaware (Figure 1, Plate 1). Field investigations were carried out from December 1989 to March 1990 by the University of Delaware Center for Archaeological Research (UDCAR) for the Delaware Department of Transportation (DelDOT) and the Federal Highway Administration (FHWA) under Section 106 of the National Historic Preservation Act to mitigate the effects of the proposed relocation and dualization of Delaware Route 896 on significant, or potentially significant, cultural resources as defined by the National Register of Historic Places (30CFR60).

Plate 1

Air View of Brennan Site Location in Relation to Route 896

Site Setting and Environment

The Brennan Site is located in the extreme western portion of New Castle County, approximately 2 km east of the Delaware/Maryland state line (Figure 1). The site is located in the Coastal Plain physiographic zone — the most extensive physiographic zone in the state. The Coastal Plain consists of southward dipping sedimentary strata which are underlain by south and southeasterly sloping schists, gneisses, and migmatites of the Wissahickon Formation (Spoljaric 1972:3). Topography in the Coastal Plain is generally flat, with shallow stream valleys and elevations typically between 12 and 24 m above sea level. This topography is in contrast to the deeply incised stream valleys and steeper relief of the Piedmont Uplands, which are located approximately 13 km to the north of the site. The gradients of streams emerging from the Piedmont become greatly reduced upon entering the Coastal Plain, and they consequently deposit a large amount of their bedload. The larger streams in the Coastal Plain are at least partially tidal.

Sediments of the Coastal Plain are fluvial in origin, and are composed of two major formations. The Potomac Formation is composed primarily of fine sediments (clays and silts) which were deposited on the underlying bedrock by streams running through the ancient Delaware River Valley and Piedmont (Spoljaric 1972:1). These sediments were laid down during the early Cretaceous Period and were later reworked by erosional forces which created an unconformity between them and the later Columbia deposits.

The Columbia Formation forms a nearly continuous veneer of sediments over the Coastal Plain, and reaches a thickness of up to 45 m (Jordan 1964). The deposits are primarily composed of unconsolidated, medium and coarse grained sands of quartz and feldspar, with admixtures of sandstone, vein quartz, and chert gravel (Jordan 1964; Thompson 1976:105). The Columbia Formation was formed from the glacial outwash deposits of watercourses emerging from the Piedmont to the north and northeast. The Columbia Formation deposits are bedded in a generally north to south direction; moving south on the Delmarva Peninsula particle sizes decrease and sediments become better sorted (Jordan 1964:14).

Studies by Spoljaric (1967:10) suggest that most of the Delaware Coastal Plain was submerged when glacial floodwaters were at their peak. At other times, interstream areas and islands were present. Two ancient channel systems have been identified in New Castle County (Spoljaric 1967). In the section of the county south of the Chesapeake and Delaware Canal, the Pleistocene channel system has a braided pattern with islands and bars separating the individual channels. North of the canal are two large, prominent channels, which are connected by a shallower interchannel. The western channel runs north to south and includes the location of the Brennan Site. Thompson (1976:14) has postulated that the topographic highs in the vicinity of the site are the result of these channel deposits. While there is no clear consensus on the exact timing of these deposits, there is a general agreement that they derive from episodes of glacial outwash of the Pleistocene Epoch (Jordan 1964).

Custer (1984, 1989) distinguishes between an upper and lower Coastal Plain, based on the extent of the very coarse gravel deposits in Columbia Formation sediments. The boundary between the two zones is located near the Smyrna River, and represents the border between the coarser gravel deposits of the upper Coastal Plain and the finer heavily reworked sands of the lower Coastal Plain. The gravel deposits have a greater resistance to erosion, and have created a more varied and steeper topography, with a correspondingly higher seasonal diversity of plant communities. Water courses are more deeply incised than those of the lower Coastal Plain and are covered with a veneer of Holocene-age sediments which become thicker towards their mouths.

The Brennan Site is located on the northeastern section of the Mid-Peninsular Drainage Divide, a zone of slightly elevated land which runs nearly the entire length of the state. The Divide separates the headwaters of streams which drain eastward into the Delaware River from those which drain westward into the Chesapeake Bay. The region is characterized by headwater drainages, bay/basin features, and both swampy and well-drained areas in close proximity, creating a mosaic of edaphic settings (Custer 1984:26). Elevations of the Drainage Divide are generally between 18 and 24 m above sea level.

Approximately 8 km north of the Brennan Site are Iron and Chestnut hills, which are Piedmont outliers composed primarily of igneous bedrock such as gabbro, norite, and pyroxenite (Spoljaric 1972:11). The exact origin of the bedrock formations is unclear (Spoljaric 1972:11). In addition to the igneous rocks, siliceous jasperoids also occur in the formation, although their origin is also questionable. The cryptocrystalline materials are either secondary replacement jasperoids, or lateritic jaspers produced from the weathering of igneous regolith (Custer, Ward and Watson, 1986:3; Custer and Galasso 1980:2). Regardless, primary outcrops of the micro- to cryptocrystalline jasperoids are available in the vicinity of Iron and Chestnut hills. Although much of the bedrock contains crystalline inclusions and other imperfections that make it unsuitable for stone tool manufacture, a substantial amount of useable jasper is present.

The Brennan Site is on a south facing slope overlooking the headwaters of an unnamed stream 180 m to the southwest. The stream flows southeast into Lum's Millpond, a nineteenth century impoundment, which in turn drains into the Chesapeake and Delaware Canal. Historic maps drawn both before and after the canal was constructed in the 1820s (1824-1829) suggest that this stream is the headwaters of what was once St. George's Creek, a tributary of the Delaware River (Latrobe 1803; Rea and Price 1849). The headwaters of Long Creek, which is in the Chesapeake Bay Drainage, are located less than 1070 m to the northwest, indicating that the site sits in the middle of the very narrow drainage divide. Wooded marshland is presently located 790 m to the northwest of the Brennan Site. Elevations in the immediate vicinity of the site are 24 m above mean sea level, and the area has very low relief.

Soils at the Brennan Site fall into general Matapeake-Sassafras Association, which are nearly level to steep, well and poorly drained soils with medium and moderately coarse textured soils on the uplands (Matthews and Lavoie 1970). The specific soil type of the Brennan Site is Sassafras sandy loam. Soils of the Sassafras Series are deep, well-drained soils on uplands with 2% to 5% slopes, and have developed in beds of older sediments that contain moderate amounts of silt and clay (Matthews and Lavoie 1970). Just to the south of the site is a small area of Elkton silt loam, which is a poorly-drained soil. To the east and west are extensive areas of poorly-drained Fallisington and Elkton series soils on either side of a discontinuous ridge of well-drained Sassafras and Matapeake series soils (Matthews and Lavoie 1970). The modern limit of tidal marsh is 975 m southeast of the site near the headwaters of St. George's Creek.

In sum, the Brennan Site is located in a diverse and productive environmental setting. It is adjacent to abundant fresh water sources, which are favorable hunting and gathering locales. It is in the vicinity of a freshwater/saltwater interface which allows for a wide range of resources, and primary outcrops of lithic raw material are located a short distance away.

Regional Prehistory

The prehistoric archaeological record of the New Castle County area can be divided into four blocks of time (Table 1): The Paleo-Indian Period (ca. 12,000 B.C. - 6500 B.C.), The Archaic Period (6500 B.C. - 3000 B.C.), the Woodland I Period (3000 B.C. - A.D. 1000), and the Woodland II Period (A.D. 1000 - A.D. 1650). A fifth time period, the Contact Period, may also be considered and includes the time period from A.D. 1650 to A.D. 1750, the approximate date of the final Indian habitation of northern Delaware in anything resembling their pre-European contact form. Each of these periods is described below and the descriptions are summarized from Custer (1984) and Custer and DeSantis (1986).

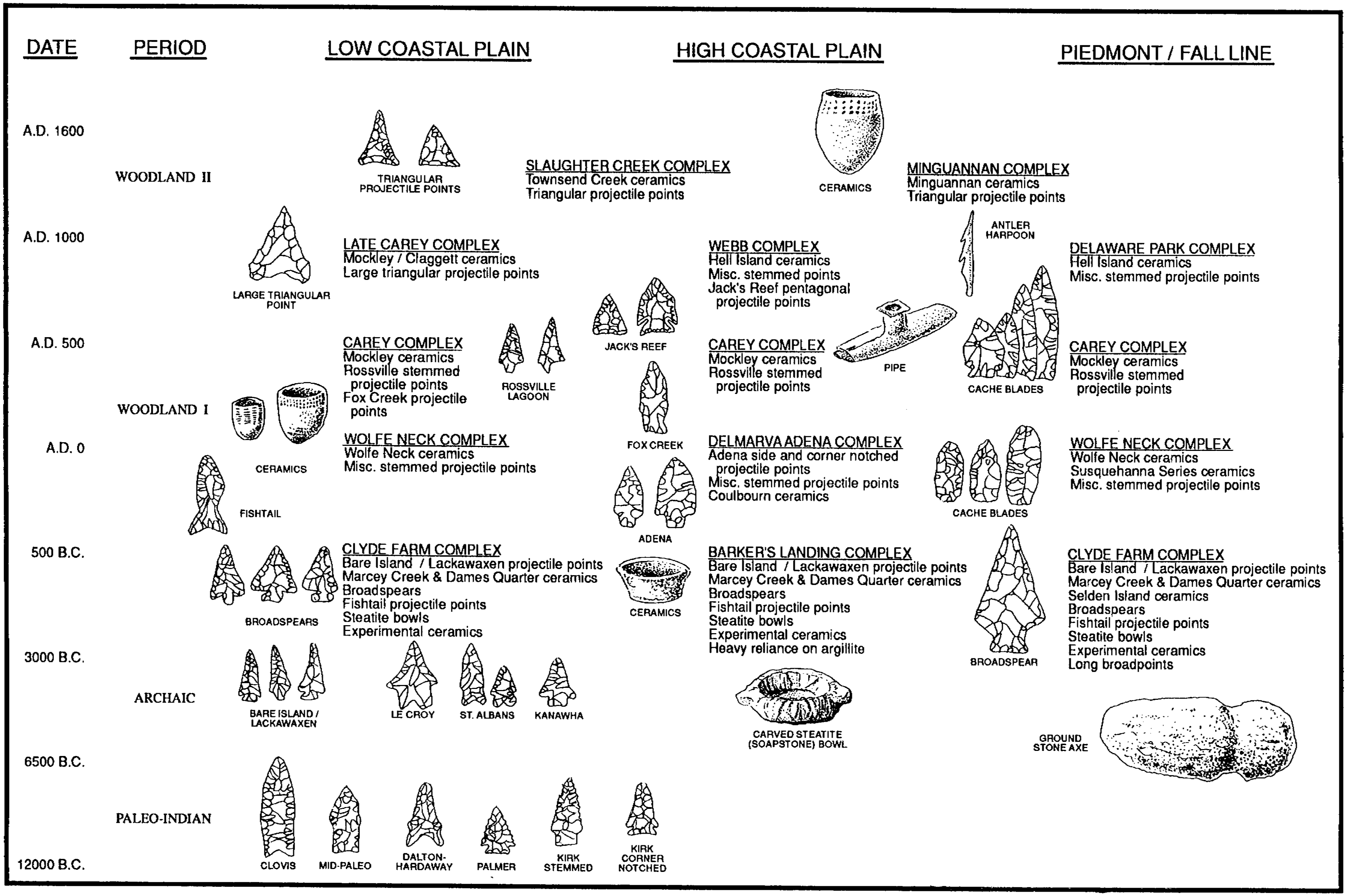
Paleo-Indian Period (12,000 B.C. - 6500 B.C.). The Paleo-Indian Period encompasses the time period of the final disappearance of Pleistocene glacial conditions from Eastern North America and the establishment of more modern Holocene environments. The distinctive feature of the Paleo-Indian Period is an adaptation to the cold, and alternately wet and dry conditions at the end of the Pleistocene and the beginning of the Holocene. This adaptation was primarily based on hunting and gathering, with hunting providing a large portion of the diet. Hunted animals may have included now extinct megafauna and moose. A mosaic of deciduous, boreal, and grassland environments would have provided a large number of productive habitats for these game animals throughout northern Delaware. Watering areas would have been particularly good for hunting.

Tool kits of Paleo-Indian groups were oriented toward the procurement and processing of hunted animal resources. A preference for high quality lithic materials has been noted and careful resharpening and maintenance of tools was common. A life-style of movement among game-rich environments with social units organized around on single and multiple family bands has been hypothesized. Throughout the 5500 year time span of the period, the basic settlement structure remained relatively constant with some modifications as Holocene environments developed at the end of the Paleo-Indian Period.

Numerous Paleo-Indian sites are known for northern Delaware including hunting and processing sites near Hockessin (Custer and DeSantis 1986) and adjacent to the Wilmington Medical Center (Custer, Catts, and Bachman 1982), possible quarry sites near Iron Hill, and

TABLE 1

Cultural Complexes of Delaware



isolated point finds. Although no clear-cut associations have yet been found, it is also hypothesized that bay/basin features may have also attracted Paleo-Indian groups (Custer, Cavallo, and Stewart 1983).

Archaic Period (6500 B.C. - 3000 B.C.). The Archaic Period is characterized by a series of adaptations to new environments. Increased warmth and fluctuations in moisture created a mosaic of forests of oak and hemlock. Many large grazing animals hunted during Paleo-Indian times became extinct. Sea-level rise also became a factor in northern Delaware during the Holocene Period. One impact of sea-level rise was to raise the local water table, which helped to create a number of large swamps, such as Churchmans Marsh. Human adaptations changed from the hunting focus of the Paleo-Indian Period to a more generalized foraging pattern in which plant food resources played a more important role. Large swamps, such as Churchmans Marsh, may have provided enough resources to support large base camps like the Clyde Farm Site. Many small procurement sites at favorable hunting and gathering locales are also known throughout northern Delaware.

Archaic Period tool kits were more generalized than earlier Paleo-Indian tool kits and included a wider array of plant processing tools, such as grinding stones, mortars, and pestles. A mobile life-style was probably common with a wide range of resources and settings exploited seasonally. A shifting band-level social organization with group size waxing and waning in relation to resource availability is evident in the archaeology of the region.

Woodland I Period (3000 B.C. - A.D. 1000). The Woodland I Period can be correlated with dramatic changes in local climates and environments that were part of events occurring throughout the Middle Atlantic region. In general, the climate cooled somewhat and became wetter. However, a warm and dry period occurred from approximately 3000 B.C. to 1000 B.C. Mesic forests were replaced by xeric forests of oak and hickory, and grasslands again became common. Some interior streams dried up, but the overall effect was redistribution of resources across the landscape, and not a deterioration. Continued sea-level rise also transformed many areas of the Delaware River and Bay shore into large, brackish-water marshes especially high in biological productivity.

The major changes in environment and resource distributions caused a radical shift in the adaptations and economies of prehistoric groups. Important areas for settlements included the major river floodplains and estuarine swamp/marsh areas. Large base camps with fairly large numbers of people are evident in many areas of northern New Castle County such as the Delaware Park Site, the Clyde Farm Site, the Crane Hook Site, and the Naamans Creek Site. These sites supported many more people than previous base camp sites and may have been occupied nearly year-round. The overall tendency was toward a more sedentary life-style.

Woodland I tool kits show some minor variations, as well as some major additions, from previous Archaic tool kits. Plant processing tools became increasingly common and seem to indicate intensive harvesting of wild plant foods that may have approached the efficiency of horticulture by the end of the Woodland I Period. Chipped stone tools changed little from the preceding Archaic Period; however, broad-bladed, knife-like processing tools became more common. Also, non-local lithic raw materials indicate that trade and exchange systems with other groups were beginning to develop. Stone, and then ceramic, containers are also added to the material culture assemblage. Durable containers allowed more efficient cooking of certain types of food and may also have been used to store surplus food. Storage pits and house features during the Woodland I Period are also known from the Delaware Park Site and the Clyde Farm Site. Social organization also seems to have undergone radical changes. With the onset of relatively sedentary life-styles and intensified food production, which might have produced occasional surpluses, incipient ranked societies may have begun to develop, as indicated by the presence of extensive trade and exchange and some caching of special artifact forms. By the end of the Woodland I Period, people in northern Delaware lived a relatively sedentary life-style.

Woodland II Period (A.D. 1000 - A.D. 1650). In many areas of the Middle Atlantic, the Woodland II Period is marked by the appearance of agricultural food production systems; however, settlements of the Woodland I Period, especially the large base camps, were also occupied during the Woodland II Period and very few changes in basic life-styles and artifact assemblages are evident (Stewart, Hummer, and Custer 1986). Intensive plant utilization and hunting remained the major subsistence activities up to European contact. Similarly, no major changes are seen in social organization for the Woodland II Period of northern Delaware.

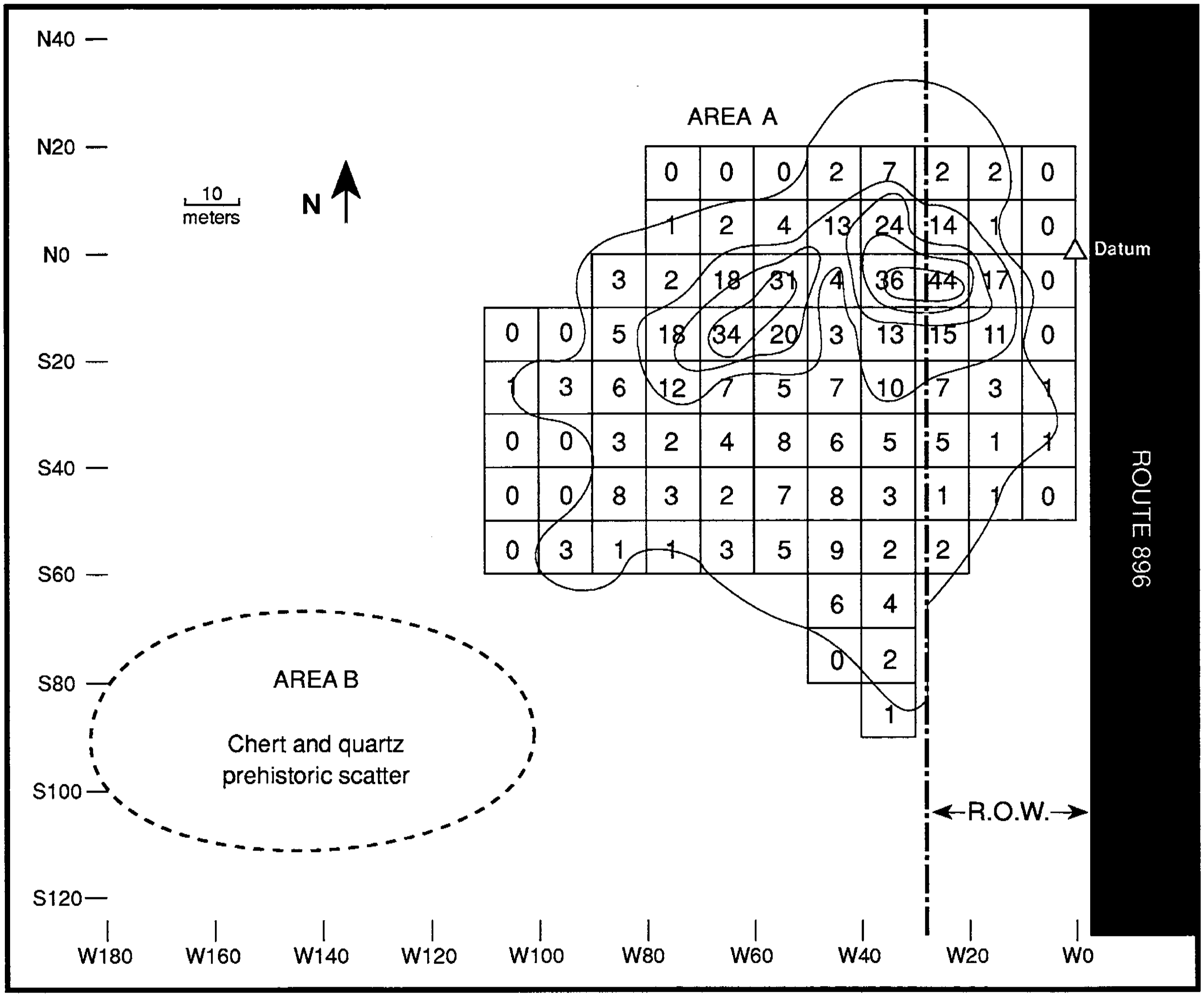
Contact Period (A.D. 1650 - A.D. 1750). The Contact Period is an enigmatic period of the archaeological record of northern Delaware which began with the arrival of the first substantial numbers of Europeans. Few Native American archaeological sites that clearly date to this period have yet been discovered in Delaware, although numerous Contact Period sites are evident in southeastern Pennsylvania. It appears that Native American groups of Delaware did not interact much with Europeans and were under the virtual domination of the Susquehannock Indians of southern Lancaster County, Pennsylvania. The Contact Period ended with the virtual extinction of Native American lifeways in the Middle Atlantic area. Only a few remnant groups remain.

Previous Research

The Brennan prehistoric site (7NC-F-61A) was discovered during a Phase I/II location/ identification survey of the Route 896 corridor from Route 4/West Chestnut Hill Road to the Summit Bridge Approach (Lothrop, Custer, and De Santis 1987). A Phase I surface reconnaissance along the west side of Route 896, 300 m north of Denny Road, revealed an extensive scatter of prehistoric artifacts consisting primarily of jasper debitage. Designated area "A," it extended 100 m west of Route 896, and was bounded on the north by an east-west trending ridge (Figure 2). From this ridge, the artifact scatter extended 70 m to the south downslope. A large portion of the jasper scatter was located within the proposed right-of-way. A second scatter of prehistoric artifacts was also identified at this time, and was labeled Area "B" (Figure 2). Area B consisted primarily of quartz and chert debitage, but was found to lie entirely outside of the proposed right-of-way.

FIGURE 2

Phase I / II Testing, Areas A and B



Phase II investigations in Area A consisted of a controlled surface collection and the excavations of 34 1 x 1 m test units, yielding approximately 1,150 prehistoric artifacts. Two areas of high artifact density were identified from the controlled surface collection around grid points S5W30 and S10W60 (Figure 2). Recovered artifacts included three cores, a unifacial tool, two Woodland I Period projectile points, and jasper flakes. One-half of the easternmost of the two concentrations was located within the proposed right-of-way and was subjected to subsurface testing. Test units were placed in the central portion of the eastern concentration in order to determine stratigraphic context and to test for potential subsurface features. The plow zone was excavated as one level. The remainder of the excavations were by 5 cm arbitrary levels until culturally sterile subsoils were encountered. Table 2 is a summary catalog of the artifact

TABLE 2

Summary Catalogue for Phase I/ II Testing

Debitage Recovered by Raw Material Type (less cores)

	Jasper	**Quartz**	**Quartzite**	**Chert**	**Other**
Surface collection	501	3	2	2	0
Plow zone excavation	553	0	2	3	1
Sub-plow zone excavation	103	0	0	0	0
Total	1157	3	4	5	1

Tool and Cores Recovered

Surface collection	**Jasper**	**Quartz**
Unifacial tools	1	---
Cores:		
bifacial	2	---
other	1	---
Finished projectile points	1	1
Late stage point preforms	2	---
Utilized flakes	3	---
Total	10	1

Excavation	**Jasper**	**Quartz**
Unifacial tools	1	---
Cores:		
bifacial	1	---
other	1	---
Total	3	0

assemblage from Phase I and II testing at the site. Artifact densities in the excavated units conformed to those of surface collected materials, and the artifacts were of similar types. The majority of artifacts were recovered from the plow zone, but artifacts were found in the sub-plow zone soils in thirteen of the 34 units. In nine of the units, the artifacts were located within 5-10 cm of the plow zone/subsoil interface, but four units produced artifacts at depths of up to 63 cm below surface. The deeper artifacts were associated with a sandy clay and gravel stratum presumably deriving from late Pleistocene or early Holocene Columbia Formation deposits. It was thought that prehistoric artifacts associated with this stratum might predate the Woodland I Period material from the plow zone. Additional testing of the deeper artifact-bearing soils indicated that they were horizontally restricted to the areas around S7W27/S8W27 and S9W32/ S10W32.

FIGURE 3

Phase II Testing, Area A Plow Zone Artifact Frequencies

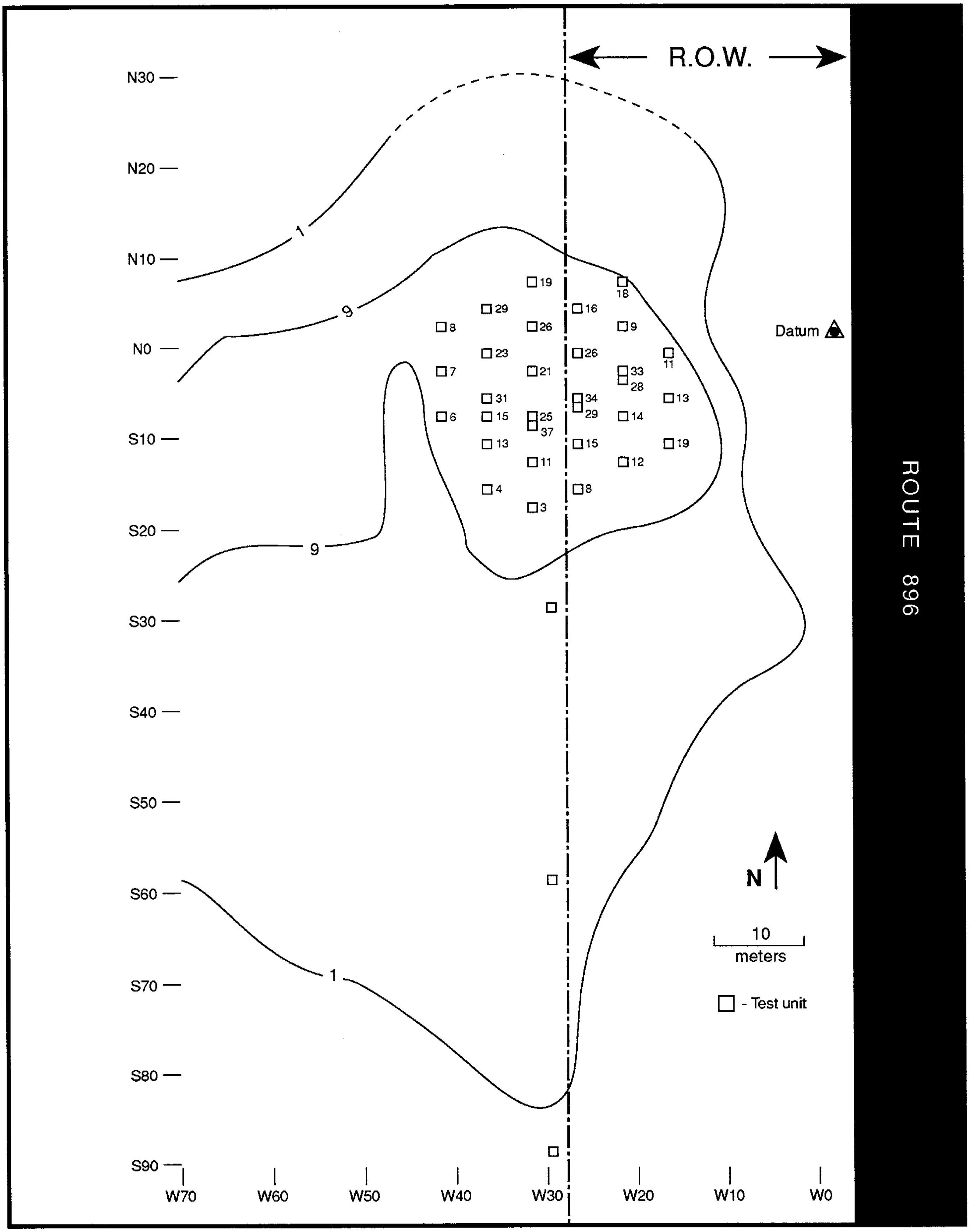
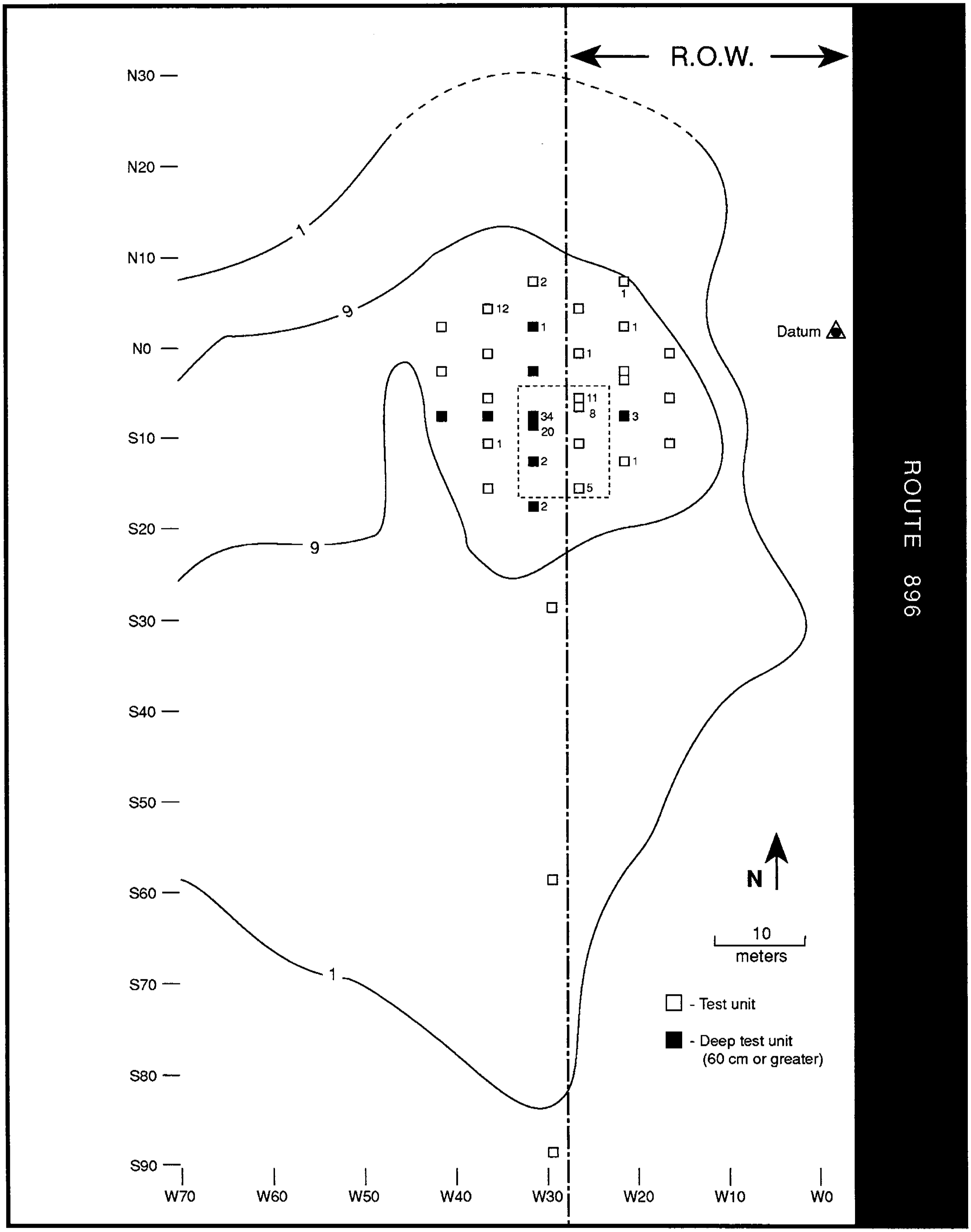


FIGURE 4

Phase II Testing, Area A Subsoil Artifact Frequencies



Area A of the Brennan prehistoric site was thought to be a Woodland I Period procurement site, representing the locus of a specialized station for secondary reduction of Delaware Chalcedony Complex jaspers (Lothrop, Custer and De Santis 1987:95). As such, it was determined to be eligible for inclusion on the National Register of Historic Places under criterion "D." The Brennan Site presented the opportunity to study the procurement and processing of Delaware Chalcedony Complex raw materials at a greater distance from their original source than most previous studies. In addition, the presence of intact sub-plow zone artifact deposits at a prehistoric site located on the Mid-Peninsular Drainage Divide provided a rare opportunity to observe relatively undisturbed artifact patterning in this setting. According to the State Management Plan, the archaeology of the Woodland I Period of the Mid-Peninsular Drainage Divide is poorly-known, and the Brennan Site was thought likely to yield significant data.

Research Questions and Methods

Research Questions. Phase I/II testing in Area A of the Brennan Site revealed the presence of a large scatter of jasper debitage and tools distributed over approximately 10,000 sq. m. Controlled surface collection of the area revealed two adjacent but distinct concentrations of jasper artifacts (Figure 2). Testing of the eastern concentration produced artifacts in plow zone soils and also in buried deposits found at the high density center of the concentration (Figures 3 and 4). This center is bracketed by grid coordinates S5-15 and W25-35, a 100 sq. m area.

The primary goal of Phase III excavations was to collect data on secondary reduction activities and core use at the eastern jasper concentration, an area which will be affected by proposed construction. Two major research issues will be addressed: 1) the specific technological aspects of jasper reduction; and 2) the role of jasper core technology in the overall activities that took place at the site.

Phase III excavations (Plates 2 and 3) were conducted within the central area of Phase II higher artifact density. Using the datum established during Phase II testing, a grid of 100 1 m sq.units was laid in from S5 to S15, and W25 to W35. Phase II test units S9W32 and S10W32 were among six Phase II units included within this grid, and both of these units had produced large numbers of artifacts in the plow zone, as well as artifacts in sub-plow zone soils. Initial Phase III investigations consisted of the excavation of 23 contiguous 1 m sq. units adjacent to these Phase II units (Figure 5). Eighteen additional 1 m sq. units were excavated to the south of this block, around Phase II unit S14W32 (Figure 5). In the eastern half of the 100 m sq. grid, five more 1 m sq. units were dug, primarily along the eastern edge of the grid (Figure 5).

Preliminary findings of the Phase III excavations did not conform with expectations based on Phase II testing of the site. The number of artifacts recovered from sub-plow zone contexts had been reasonably high in Phase II test units S7-8 W27 and S9-10 W32 (Figure 4), and Phase III units in the vicinity of S8-9 W32 also produced high numbers of artifacts below the plow zone (Figure 4). However, Phase III excavation in other parts of the site revealed much smaller numbers of artifacts in Level 2 and below (Figure 6). The 542 artifacts recovered from the subsoil represented 29% of the total number of artifacts found during Phase III excavations up to that point. The majority of the artifacts (69%) were found in the first 10 cm below the

Plate 2

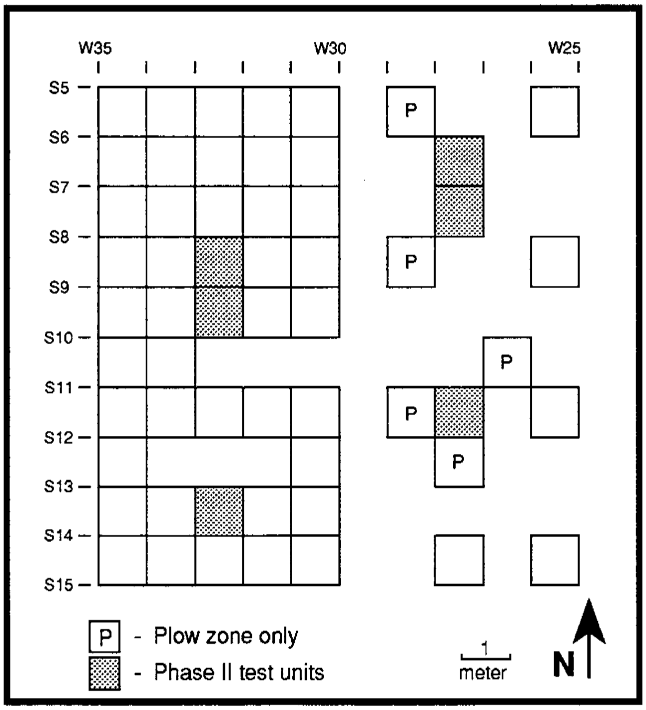
View of Phase III Excavation Units

Plate 3

Phase III Excavations in Progress

FIGURE 5

Phase III Excavations



plow zone; therefore, only 9% of the total artifacts at the site had been recovered from deposits deeper than 10 cm beneath the base of the plow zone. The number of artifacts dropped steadily with each 5 cm level below the plow zone.

The implications of this information were twofold. First, the low number of artifacts found below the plow zone, and their steady decrease in number with depth, suggested that a buried living surface or intact occupation was not present at the site. Secondly, the fact that the majority of artifacts found below the plow zone were located within the first two levels (10 cm) of the subsoil (and steadily decreased in number below that) suggested that the artifacts had migrated through the soil profile as a result of natural processes, such as root or rodent disturbances, and were no longer in their original location. It was also possible that the below-plow zone artifacts were from cultural features that were no longer visible due to pedogenesis.

Additional testing was warranted to determine the origin of below-plow zone artifacts. To accomplish this, standard statistical tables (Selby 1992) were used to determine an appropriate sample size of 50 cm sq. blocks (the minimum provenience unit for subsoil excavations), based on the number of blocks already excavated. These additional sample blocks would be excavated outside the area of high sub-plow zone artifact densities, in sections of the site with soils thought to be too old to contain culturally-deposited artifacts.

Ten 50 cm sq. test units were excavated at two meter intervals to the east of the Phase III excavation area, outside the portion of the site which contained the highest density of artifacts in the subsoil (Figure 7). Most of the units were excavated eleven 5 cm levels below the plow zone, thus creating a sample of 105 - 50 cm sq., 5 cm thick blocks. Six (5.7%) of the blocks had artifacts.

FIGURE 6

Total Artifacts Below Plow Zone

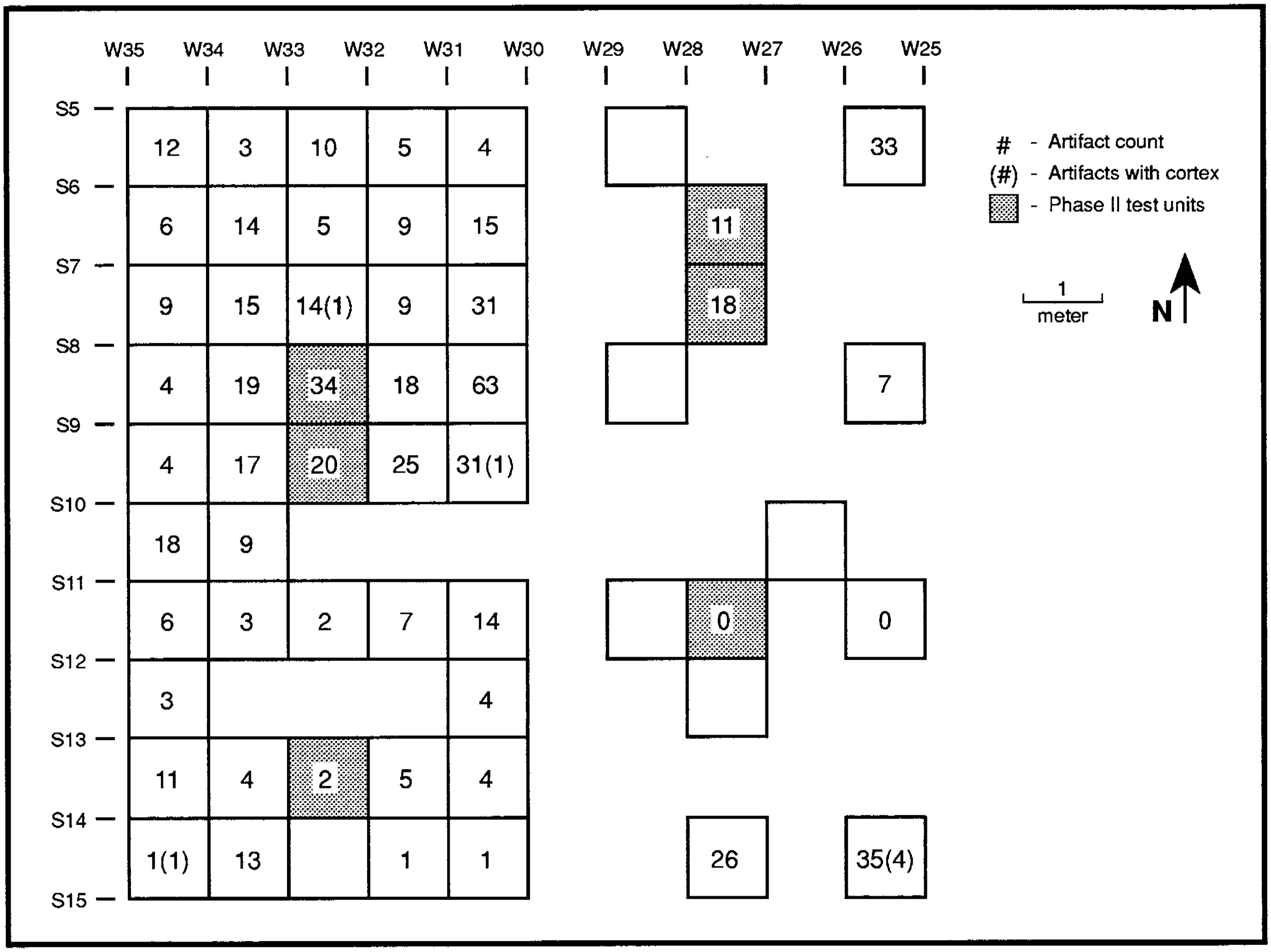
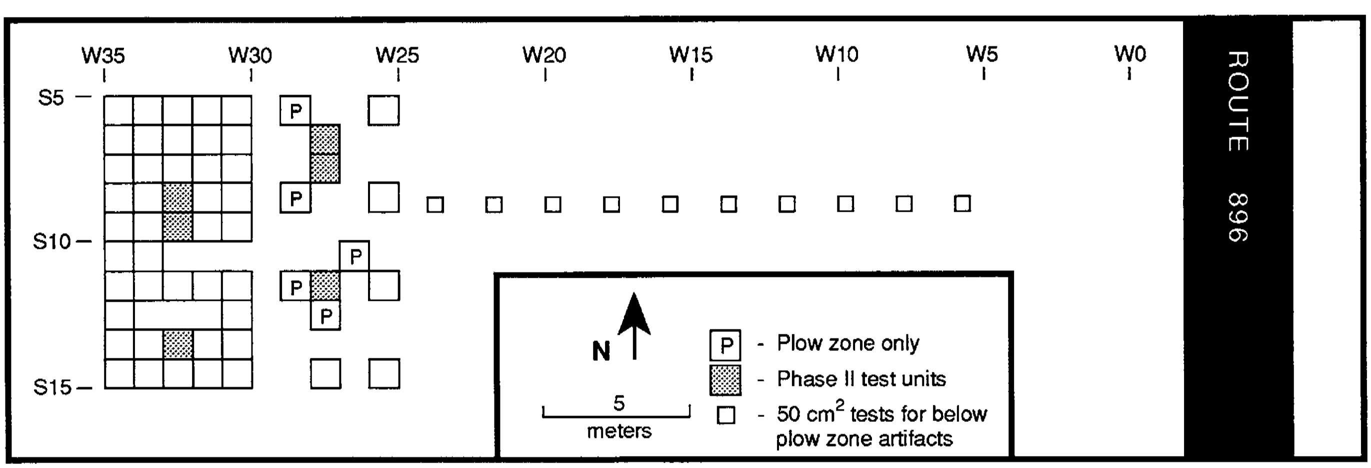


FIGURE 7

Additional Units for Sub-Plow Zone Sample Testing



The recovery of artifacts in Pleistocene-age soils directly below the plow zone in the test area east of the Phase III excavation area indicated that natural movement of artifacts had taken place at the site, and that the concentration of artifacts found in the Phase III section of the site was not unique, even though the subsoils in that area were post-Pleistocene in age. Based on this conclusion, no further excavation of sub-plow zone soils was undertaken at the site.

Methods. The plow zone of all units was removed and screened as a single stratigraphic unit. All levels below the plow zone were excavated in 5 cm arbitrary levels within natural levels. With the exception of the five units in which only the plow zone was excavated in order to obtain a larger sample of artifacts, all units were excavated until Pleistocene-age soils were encountered. If artifacts were found within 10 cm (2 levels) of this boundary, excavations continued until two continuously sterile levels were removed. If four continuous 5 cm levels were found to be sterile, excavation switch to 10 cm levels. In total, 51 1 m sq. test units were excavated within the center of Area A of the Brennan Site during Phase III investigations.

Each 1 m sq. unit was subdivided into four 50 cm sq. quadrants, labeled by the compass coordinates of its southeast corner. The quadrants were the minimum provenience unit. All excavated soils were screened through 1/4-inch mesh screen. A soil sample and one non-cultural rock were recovered from each level in each unit to be used as a control for blood residue analysis. Soil profiles were recorded for all units. Photographs were taken and maps were drawn of all potential features. Two 50 cm sq. quadrants from the north and south halves of the site were retained for flotation analysis, and two soil column samples were recovered from the same areas.

All soil and non-cultural rock samples were tested for false-positive blood residue reaction using protocols established at the University of Delaware Center for Archaeological Research (Custer, Ilgenfritz, and Doms 1988). In areas with no contamination, all tools and a sample of flakes were then tested for blood residue. After this process, all artifacts were washed and labeled according to standards established at the Island Field Museum.

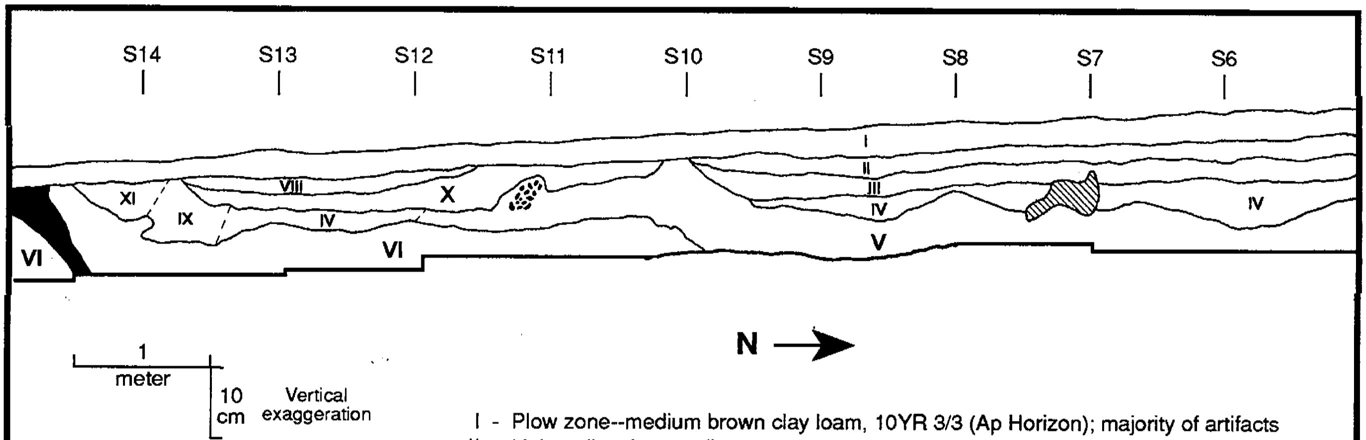
EXCAVATION RESULTS AND INTERPRETATIONS

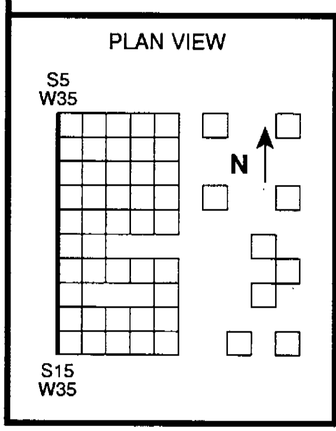
Site Stratigraphy

Composite profiles of the Brennan Site stratigraphy are shown in Figures 8-11. Horizon I is the plow zone which covers the entire site to a fairly uniform depth of approximately 20 cm. The majority of artifacts recovered at the site came from the plow zone. Horizon II is a B1t soil horizon of yellow brown silty clay, which is underlain in the north by a yellow brown sandy clay/ clay loam — a B2t soil, labeled as Horizon III on the profiles. Both of Horizon II and III contained prehistoric artifacts, although in lesser amounts than the plow zone. Horizon IV is a B3t soil horizon, transitional between Horizon III and the depositional parent material (C soil horizon) below it. Horizon IV is reddish brown clayey sand which contains a moderate to large amount of gravel. Horizon IV has developed on what is most likely a late Pleistocene/Early Holocene gravel with illuviated clays. Under Horizon IV is yellow brown slightly silty sand (Horizon V).

FIGURE 8

North / South Composite Profile, West Side





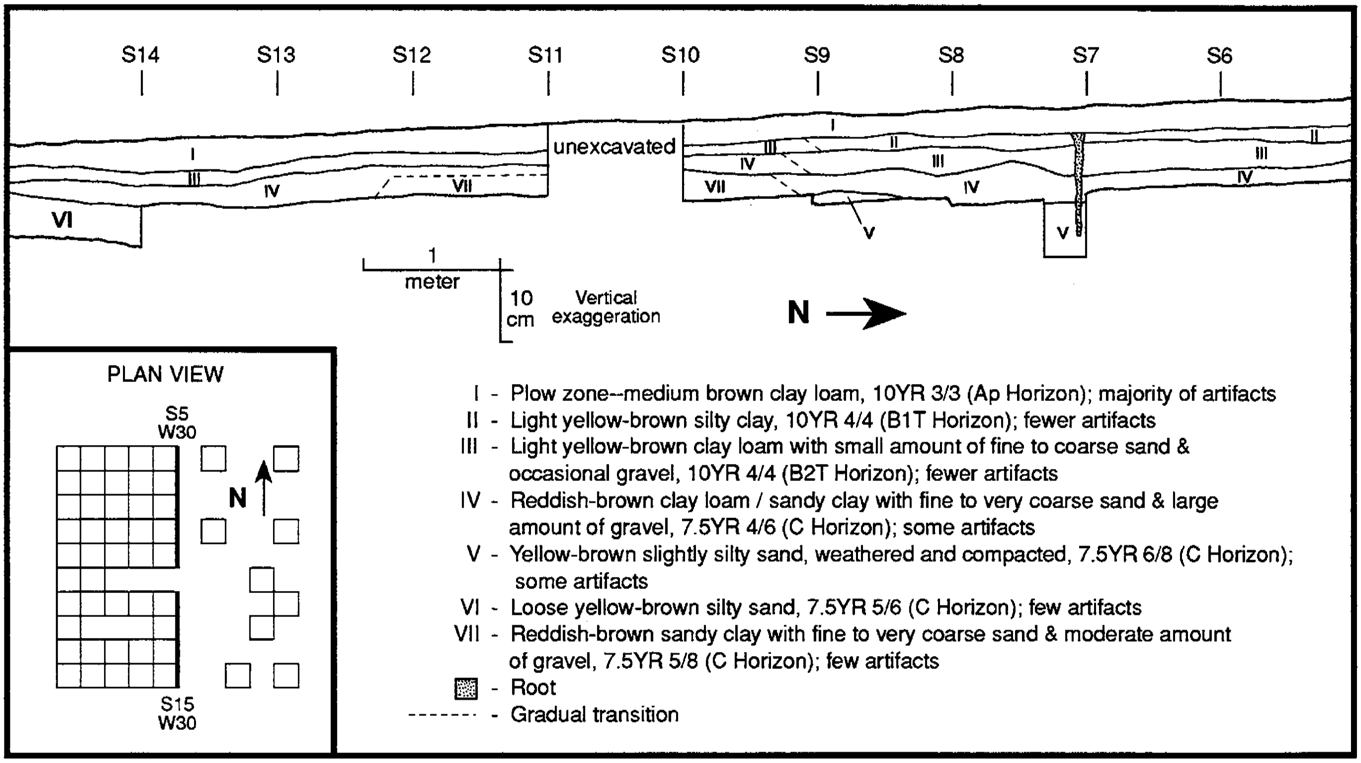
I - Plow zone--medium brown clay loam, 10YR 3/3 (Ap Horizon); majority of artifacts
II - Light yellow-brown silty clay, 10YR 4/4 (B1T Horizon); fewr artifacts
III - Light yellow-brown clay loam with small amount of fine to coarse sand & occasional gravel, 10YR 4/4 (B2T Horizon); fewer artifacts
IV - Reddish-brown clay loam / sandy clay with fine to very coarse sand & large amount of gravel, 7.5YR 4/6 (C Horizon); some artifacts
V - Yellow-brown slightly silty sand, weathered and compacted, with some gravel lenses, 7.5YR 5/4 (C Horizon); some artifacts
VI - Loose yellow-brown silty sand, 7.5YR 5/6 (C Horizon); few artifacts
VIII - Light yellow-brown clay loam with small amount of fine to coarse sand & occasional gravel, 10YR 5/4 (B Horizon); few artifacts
IX - Light yellow-brown clay loam with small amount of fine to coarse sand, 10YR 5/4 (B Horizon); few artifacts
X - Reddish-brown loam with fine to coarse sand & moderate amount of gravel, 7.5YR 4/6(B Horizon); few artifacts
XI - Reddish-brown sandy loam with very fine to fine sand, 7.5YR 4/6 (B Horizon)
- Feature 2
- Rodent disturbance
- Gravel pocket
------- - Gradual transition

In the western part of the site near 10 m south of datum, Horizon V rises abruptly, and Horizons II through IV pinch out (Figure 8). A second C Horizon soil appears under V — an unconsolidated, yellow-brown silty sand labeled Horizon VI. To the east, there are more gradual soil changes, with Horizon II grading into Horizon III, and Horizon IV becoming redder in color and rising up (Figure 9). A reddish brown sandy clay also appears below Horizon IV in the east and is labeled as Horizon VII.

The disruption of the A_p-B-C profile found in the north half of the site may also be seen in the east/west profiles at 10 and 15 m south of datum (Figures 10 and 11). In Figure 10, Horizons III and IV dip downward to the west taking on a trough-like appearance, and two new horizons were found above them. Horizon VIII is a light yellow brown clay loam, over which is

FIGURE 9

North / South Composite Profile, East Side



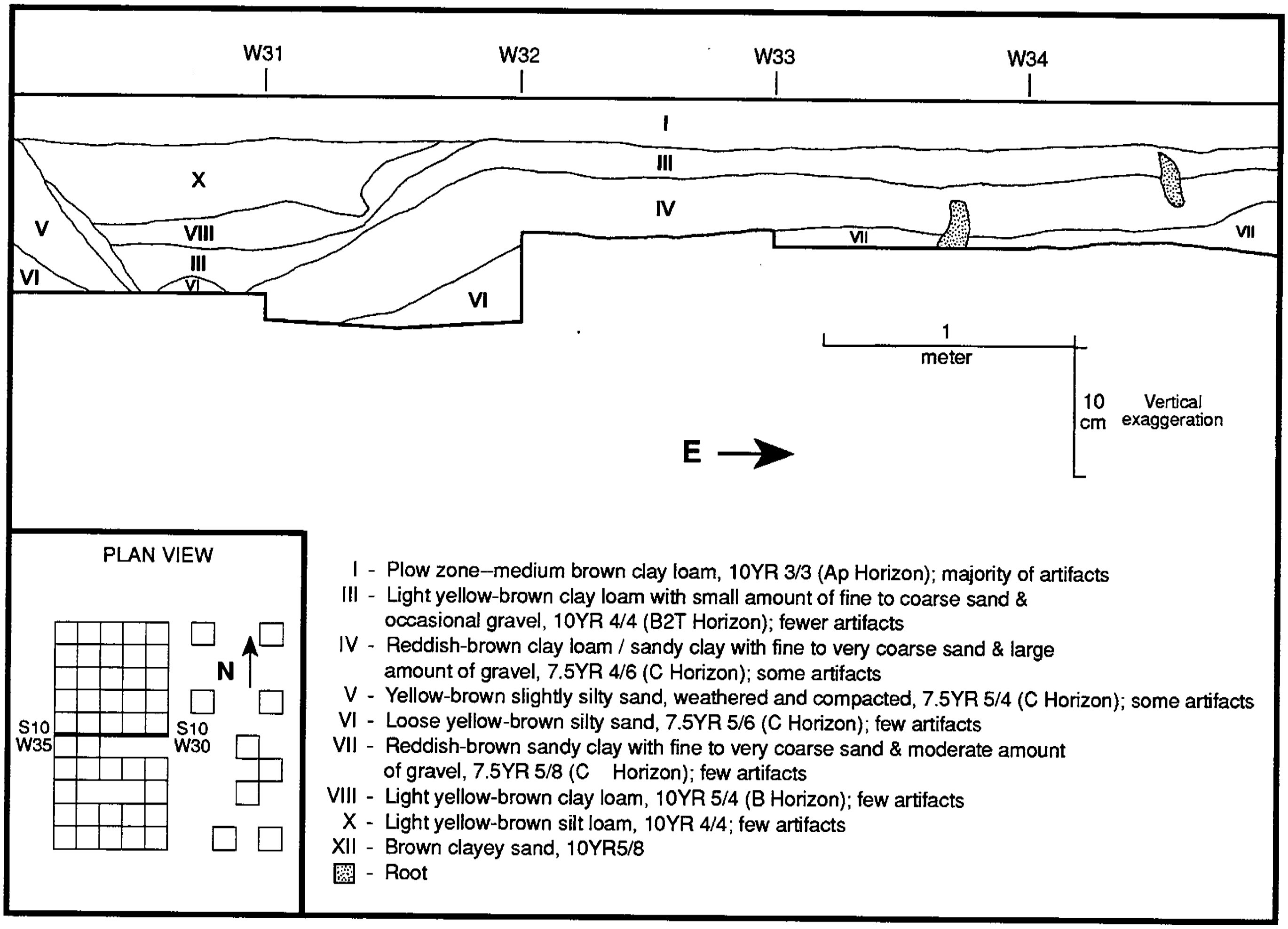
Horizon X, a light yellow brown silt loam. The amount of clay in these sediments suggests that they have undergone some soil development, but the sediments are probably depositional in origin. Horizon XII is a brown clayey sand, and may be intrusive.

A similar pattern may be seen in the southern east/west profile, except that Horizon VIII has expanded and has a slightly greater silt content. It is no longer underlain by Horizons III and IV, but rests directly on Horizon VI. Horizon VIII was originally thought to be a feature (see discussion of Feature 4 which follows) and it contained a small number of prehistoric artifacts to its deepest point, at 60 cm below the bottom of the plow zone. To the east, Horizon VIII grades into Horizon IV, and from that point east the soil profile is a less disturbed A_p-B-C sequence. The perturbations observable in Figure 11 are also visible in the south half of the western north/south profile, with two additional pockets of clay and sand loam (Horizons IX and XI). Profile disturbance, in general, occupies the southwest corner of the excavation area (Figure 8 and 11).

In sum, soil profiles below the plow zone in the northwest, northeast, and southeast sections of the site consist of two, and sometimes three, Bt horizons, below which are a series of depositional C Horizons. The formation of the argillic B horizons suggests that soils in these areas have experienced a prolonged period of stability, and the amount of clay present in the

FIGURE 10

East / West Composite Profile, Middle Section

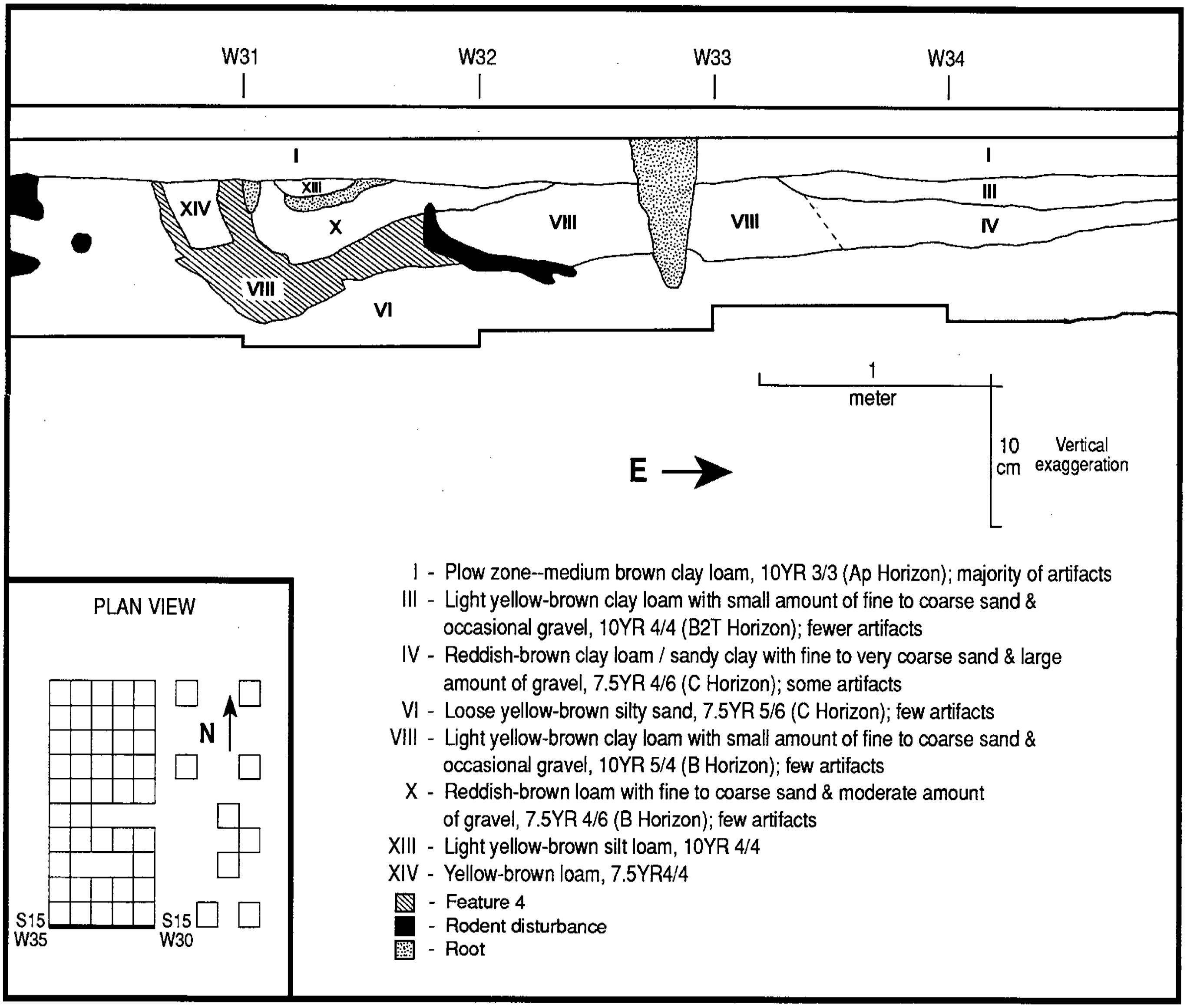


soils indicates that they are probably very old. The C horizons sediments below the soils horizons are depositional in origin, and are Columbia Formation deposits of Late Pleistocene/Early Holocene age.

The southwest corner of the site contains a series of soils in a trough or gully-like formation running northwest to southeast (Figure 12) which may represent a gully or ephemeral stream channel which was later filled with sediments. Evidence of some pedogenic development in the deposits (in Horizons X and VIII in Figure 11) suggests that the episode(s) of filling happened far enough in the past to have been completed before prehistoric people occupied the site. Although a small number of artifacts were recovered from these soils, this may be the result of the large amount of root and rodent disturbances in the area. No diagnostic artifacts were found below the plow zone at the Brennan Site.

FIGURE 11

East / West Composite Profile, Southern Section



Excavated Artifacts

A summary catalog of excavated artifacts from Phase III investigations is given in Table 3. The majority of lithic artifacts are flakes, but a small number of biface fragments, cores, and fire-cracked rock were also present. No projectile points or ceramics were found during Phase III excavations.

FIGURE 12

Southwest Corner Soil Disturbance

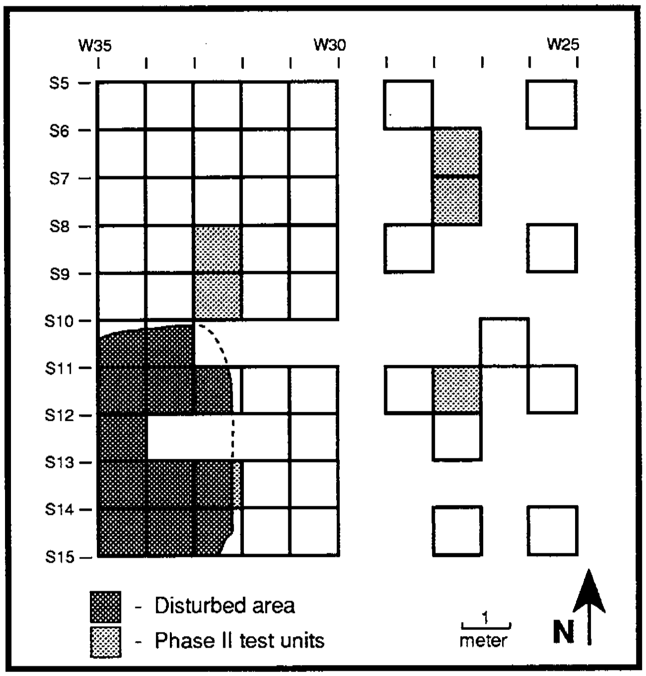


TABLE 3

Summary Catalogue for Phase III Excavations

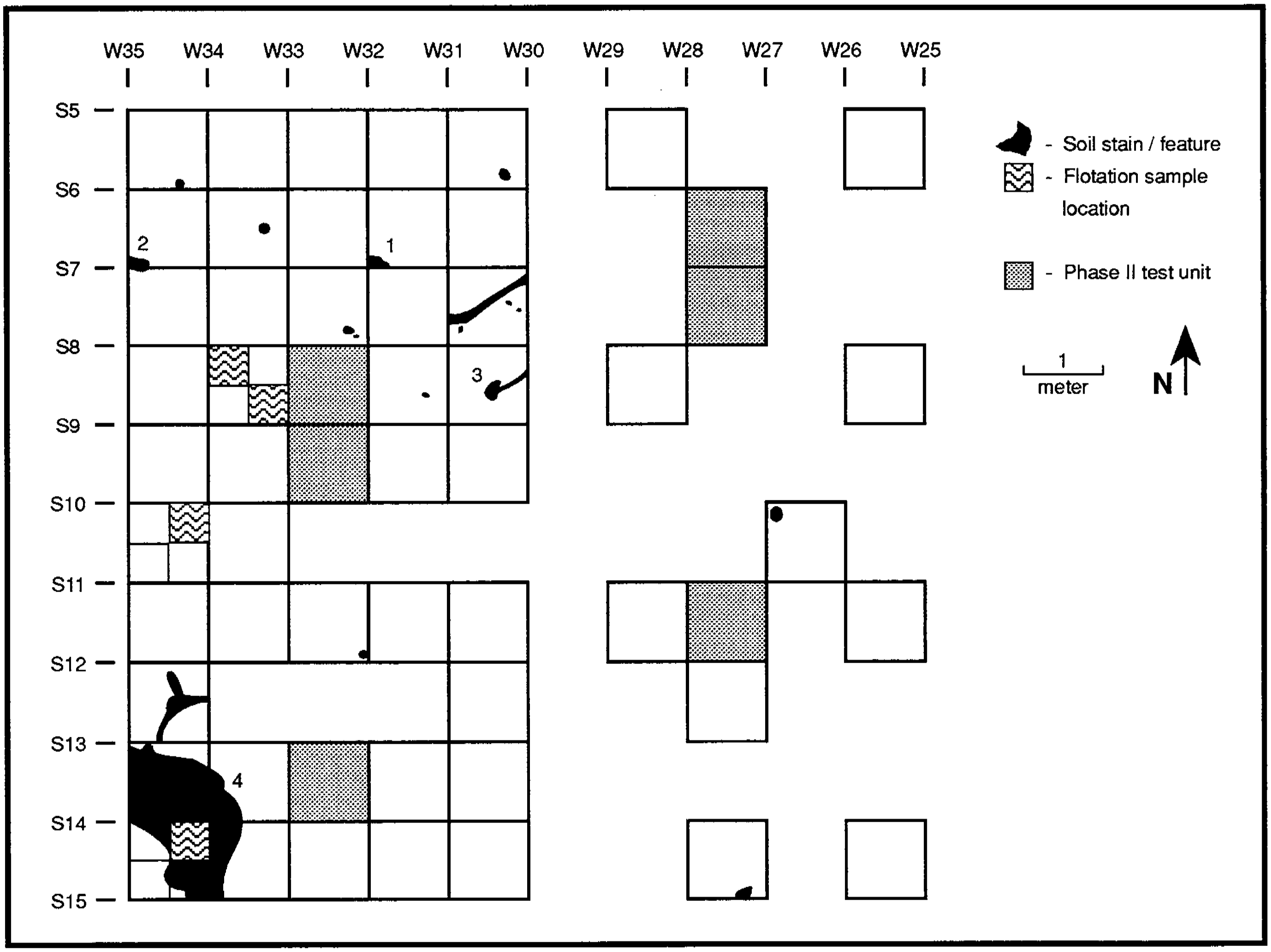
Artifact	Jasper	Quartz	Chert	Quartzite	Chalcedony	Other	Total
Points	---	---	---	---	---	---	---
Early stage biface reject	5	---	---	---	---	---	5
Late stage biface discard	1	---	---	---	---	---	1
Utilized flakes	24(1)	---	---	---	---	---	24(1)
Flake tools	12	---	---	---	---	---	12
Scrapers	1	---	---	---	---	---	1
Cores	3	---	---	---	---	---	3
Miscellaneous tools	---	---	---	---	---	1(1)	1(1)
Flakes	1844(12)	7(2)	2(1)	11(5)	10	1	1875(20)
Total	1890(13)	7(2)	2(1)	11(5)	10	2(1)	1922(22)

15 Fire-cracked rocks (3,950 g)
1 Hammerstone

KEY: ( ) = Cortex

FIGURE 13

Location of All Soil Stains and Flotation Samples



Features

Several potential features and soil stains were found in Phase III excavations (Figure 13). With one exception, all soil stains were determined to be the result of natural disturbances from tree root and rodent activity. During the excavation of Test Unit S15W33, an area of gray to orange-brown silty clay was observed in the western half of the unit at the bottom of Level 3, 10 cm below the bottom of the plow zone. This soil was excavated and screened separately to the bottom of Level 10 (45 cm below the base of the plow zone). Below Level 10 yellow-brown sands of Pleistocene age were exposed in the east half of the unit, but the gray to orange brown silty clay was still present in the west half of the unit. The remainder of the silty clay was excavated in 5 cm levels to a depth of 85 cm below the plow zone. The silty clay deposit was a steep-sided pocket of B Horizon soils which extended into units S14W33, S14W34, S15W34, S16W33, and S16W34.

Test units S14W33, S14W34, and S15W34 were opened and excavated to a depth of 35 cm below the plow zone, where the darker silty clay soil was discernible from the surrounding sandy soils. The silty clay soil was labeled Feature 4 (Figure 13). Excavation of the feature was completed in 5 cm levels that were screened separately within the boundaries of the test units in which Feature 4 was exposed. Flotation samples were also recovered from five 5 cm levels of Feature 4 (Levels 11, 12, 14, 15, and 16 in the NE quadrant of S15 W34). No artifacts were recovered from the screened soil from this feature. Two jasper microflakes and one quartz microflake were found in the heavy fractions of the flotation samples, as were two charred Amaranth seeds and 1.34 grams of charcoal (Table 4). Light fraction samples produced a number of charred Amaranth seeds as well as uncharred copperleaf (Acalypha rhomboidea) seeds.

The number of microflakes in Feature 4 is smaller than in other heavy fraction samples from non-feature soils, which is probably the result of the greater depth from which the Feature 4 samples came. The two kinds of lithic raw materials found in Feature 4 mirror the two most common found in non-feature samples. Although charred Amaranth seeds were recovered from Feature 4 light fractions, they were found in similar quantities in non-feature flotation samples. As in other flotation samples from the site, uncharred seeds were not analyzed.

In sum, the small number of artifacts and ecofacts recovered from Feature 4 are not unusual compared to other areas of the Brennan Site. Feature 4 appears as a steep-sided gully or trench-like soil anomaly, running in a NW to SE direction (Figure 12). In plan view its borders are irregular and its profile resembles an irregularly shaped basin. The irregular shape of the feature and the flotation data suggest that Feature 4 is natural, not cultural.

Floated Artifacts and Ecofacts

Flotation samples were taken from two test units and one possible feature at the Brennan Site (Figure 13). One 50 cm sq. quadrant from each of the units was selected, and all soil from that quadrant was bagged by 5 cm level and returned to the lab for processing. Each individual sample, therefore, contains 1.25 liters of sediment. All samples were then processed using a water driven flotation tank, with heavy fractions being collected in window mesh sized screen, and light fractions collected in a silk bag. After drying, all artifacts and ecofacts were removed and cataloged.

The majority of artifacts in the heavy fraction are jasper microflakes, with smaller amounts of quartz, quartzite, and chert microflakes included (Table 4). Small amounts of charcoal are also present, as are a single uncharred copperleaf seed, and a small number of charred Amaranth seeds (Table 4). Charred Amaranth seeds were also present in the light fraction samples, as were a variety of other uncharred seeds. As previously noted in the discussion of site stratigraphy, movement of artifacts through the profile has been demonstrated; therefore, the vertical position of artifacts and ecofacts from flotation will not be considered.

TABLE 4

Recovery from Flotation Samples

Heavy fraction

Square	**Micro-debitage**					**Charcoal**	**Seeds**
	Jasper	**Quartz**	**Quartzite**	**Chert**	**Other**		
S9W33 (5 samples)	48	1	1	---	1	0.15 gm	---
S11W34 (8 samples)	55	6(2)	1	2(1)	---	1.59 gm	---
Feature 4 (5 samples)	2	1(1)	---	---	---	1.34 gm	Amaranth (charred)
Total	105	8(3)	2	2(1)	1	3.08 gm	Copperleaf (uncharred)

Light fractions

Square	**Seeds** Charred	**Uncharred**
S9W33	Amaranth	Copperleaf, *Stachys*, Chenopodium, Sandwort, Mulberry
S11W34	Amaranth	Copperleaf, *Stachys*, Chenopodium, *Oxalis stricta*
Feature 4	Amaranth	Copperleaf

Comparison between the raw materials of debitage recovered from flotation and debitage recovered from 1/4-inch mesh screens are interesting (Table 5). While jasper debitage is by far the most prevalent raw material found from both general excavation and flotation, the percentage of jasper debitage recovered from flotation is somewhat lower. Conversely, the amounts of quartz, quartzite, and chert debitage from flotation is higher. The presence of quartz and quartzite flakes in the general excavation debitage indicates that some reduction of quartz and quartzite took place at the site, but the higher percentage of these materials in flotation samples may reflect fracturing characteristics of different types of stone. The larger crystalline structure of quartz and quartzite rocks would produce smaller fragments during the early stages of tool manufacture compared to cryptocrystalline materials. The high incidence of cortex on the quartz microflakes (38% with cortex) is further indication of an early stage in cobble reduction. Microflakes resulting from tool edge sharpening would not be as likely to have cortex because the outer surfaces of the tool would already have been removed during an earlier stage of manufacture.

Jasper microflakes present in heavy flotation fraction samples indicate that edge sharpening of jasper tools took place. The physical characteristics of the small flakes match the jasper debitage found in general excavation. Given the problems with determining source locations of jasper from visual inspection (see discussion in "Technologies: Stone Tool Manufacture and Use" section), it is not possible to state with absolute certainty that the jasper microflakes are from the same source as the larger flakes recovered in general excavations at the site.

TABLE 5

Comparison of Excavation and Flotation Debitage

Raw Material	Number from Flotation	Percent from Flotation	Number from 1/ 4 -inch screen	Percent from 1/ 4-inch screen
Jasper	105	89%	1844(12)	98%
Quartz	8(3)	7%	7(2)	<1%
Quartzite	2	2%	11(5)	<1%
Chert	2(1)	2%	2(1)	<1%
Chalcedony	---	---	10	<1%
Other	1	<1%	1	<1%
Total	118(4)	100%	1875(20)	100%

In sum, the artifacts recovered from heavy fraction samples indicated that edge sharpening was performed on jasper tools. The tools sharpened may have been late stage bifaces, projectile points, or flake tools, all of which were produced at the site. It is also possible (but less likely) that finished jasper tools that were brought to the site were resharpened. Non-cryptocrystalline flakes at the site are small in number, and may be shatter from the early stages of tool production. The remaining microflakes, two chert and one rhyolite, are so few in number that conclusions about them are difficult.

As previously mentioned, a variety of uncharred seeds were recovered from the light fractions of flotation samples, as were charred Amaranth seeds. Because of the evidence of artifact movement through the profile, uncharred seeds were considered to be of questionable prehistoric cultural origin and were not analyzed further. The presence of charred Amaranth seeds is also questionable. The seeds were found in similar quantities in all three flotation sample locations, and did not come from cultural features. The charred Amaranth seeds may therefore represent natural seed "fallout" from the burning of surrounding areas (Custer, Stiner, and Watson 1983), and are not the products of prehistoric human activity.

Blood Residue Analysis

Tests for the presence or absence of blood residue on lithic artifacts was undertaken, using protocols developed by the University of Delaware Center For Archaeological Research (Custer, Ilgenfritz, and Doms 1988). A sample of soil and an unmodified (non-cultural) pebble from each level of every 1 m sq. excavation unit were first tested for possible organic or chemical contamination which might produce a false-positive reaction. All of the samples tested negative, or only slightly positive, suggesting that any strong positive reaction found on artifact surfaces would be a reliable indication of the presence of blood residues. A sample representing approximately 13% of the general debitage from the plow zone was tested first. An attempt was made to test each individual flake three times on various surfaces, but the generally small size of the flakes resulted in most being tested only once. No strongly positive reactions were recorded for any of the plow zone debitage. The same procedure was repeated with a sample of the debitage from Level 2, with similar results. A small number of flakes below Level 2 were also tested, and did not produce positive reactions.

A small number of tools recovered from Phase III excavations were also tested for the presence of the blood residues. The major tool type at the site was utilized flakes, several of which were identified only after they had been thoroughly washed and were no longer suitable for blood residue testing. The utilized flakes that were tested produced negative results.

In summary, the results of blood residue testing for Brennan Site tools and debitage were negative. The results only indicate that blood residues are not now present on the artifacts, and no further interpretations are possible.

Site Chronology

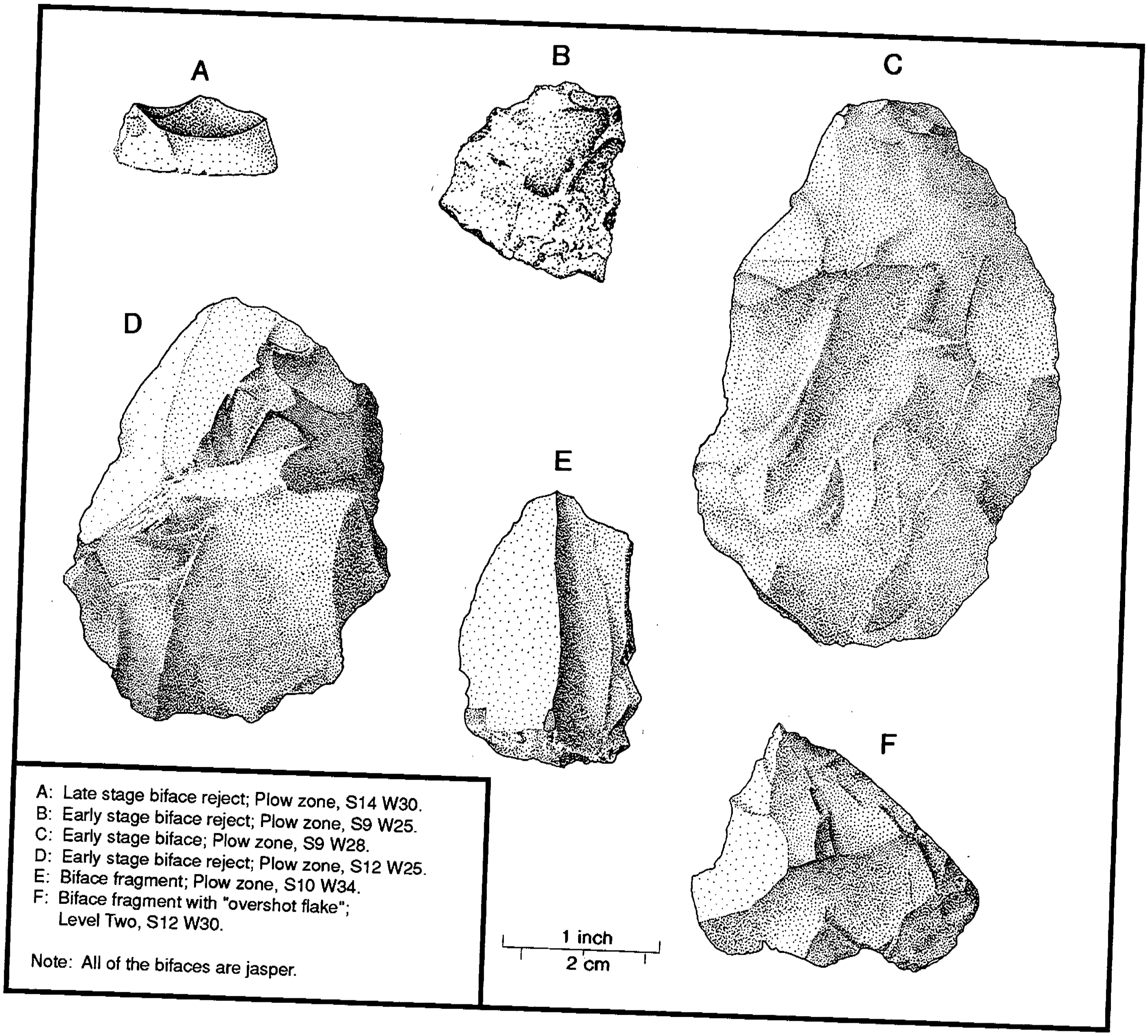
Phase I/II testing at 7NC-F-61A recovered two stemmed projectile points from a plow zone context (Lothrop, Custer, and De Santis 1987). The points were found during a controlled surface collection, and no additional diagnostic artifacts were found during Phase III excavation of both plow zone and sub-plow zone soils. The projectile points are characteristic of the Woodland I cultural period, but were not sufficiently diagnostic to allow dating at the Complex level. One of the points is made from quartz, and has such an amorphous base form that it is not possible to type. The second point is made of jasper, and has a straight stem resembling the Bare Island/Lackawaxen type (Kinsey 1972:410) which are sometimes regarded as representing an individual component of the Late Archaic (Kinsey 1959, 1972:335, 337). Other research has indicated that the distinctions among stemmed point forms are not particularly diagnostic (Custer and Bachman 1984; Watson and Custer 1990). Therefore, only the general time frame of the Woodland I Period (3000 B.C. to A.D. 1000) was assigned to the site.

Unfortunately, no additional diagnostic artifacts were recovered from the Brennan Site during Phase III excavations, nor was any organic material suitable for radiocarbon dating found. Although the first prehistoric ceramic wares in Delaware were produced ca. 1200 B.C., the absence of ceramic wares at the Brennan Site does not necessarily imply an occupation date prior to 1200 B.C. because ceramic vessels are not expected on a site of this small size and limited function (Custer 1984:104). Thus, the age of the site can only be placed within the Woodland I Period.

Technologies: Stone Tool Manufacture and Use

This section of the report describes the stone tool manufacturing technologies and stone tool use which took place at the Brennan Site. It deals primarily with artifacts recovered from Phase III excavations. Bifaces and utilized flakes are considered in the context of tool

FIGURE 14
Bifaces



A: Late stage biface reject; Plow zone, S14 W30.
B: Early stage biface reject; Plow zone, S9 W25.
C: Early stage biface; Plow zone, S9 W28.
D: Early stage biface reject; Plow zone, S12 W25.
E: Biface fragment; Plow zone, S10 W34.
F: Biface fragment with "overshot flake"; Level Two, S12 W30.

Note: All of the bifaces are jasper.

manufacturing activities, and this information, combined with the analysis of other artifact types, is used to determine stone tool functions. Finally, the stone tool technology is considered in relation to the lithic raw materials present at the site which reflects lithic procurement strategies. Tool function was determined by examining breakage patterns and edge wear. Analysis of gross morphology and wear patterns was carried out by visual and microscopic inspection.

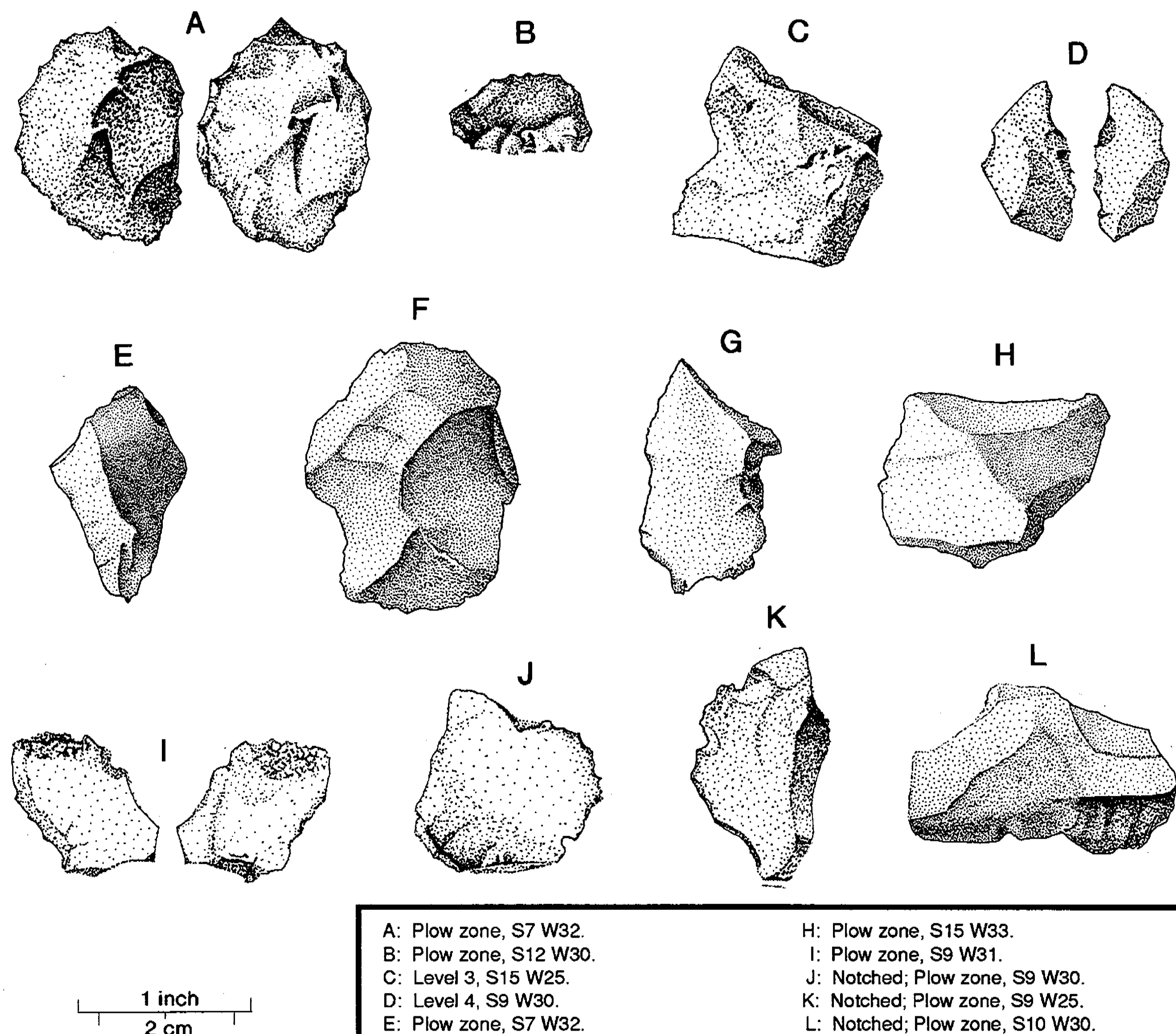
No projectile points were found during final data recovery excavations at the Brennan Site. The two points recovered during Phase II excavations (one quartz, and one jasper) were both discarded stemmed points with transverse fractures in the medial section. Both of the points were found outside of the Phase III excavation area. A total of six bifaces — two whole and four broken — were found during Phase III work. The bifaces were categorized by manufacturing stage and motive for disposal based on the work of Callahan (1979). Figure 14-A shows a discarded late stage biface with a transverse fracture. It is probably the base of a projectile point. Three of the five early stage bifaces in the Phase III assemblage are fragments rejected due to manufacturing error, most likely exacerbated by flaws in the raw material (Figure 14-B, E, F). One of these fragments (Figure 14-F) apparently resulted from a type of reduction error described by Callahan (1979:76, 86) as "overshot termination," in which a lateral thinning flake accidentally removes the opposite side of the biface. He also notes that while this is a common problem during early stage biface reduction, it does not necessarily prevent further reduction of the biface. The remaining two bifaces are whole, and were manufactured from large flakes which still retain their original platforms. One of the bifacially worked flakes (Figure 14-D) has what appears to be two additional partially prepared platforms. The biface may not have been further reduced because of iron mineral inclusions in the stone. None of the bifaces recovered from the site show signs of use, and all were made of jasper. Two small, late stage jasper bifaces were also recovered during Phase I and II investigations. They were apparently rejected due to raw material flaws which prevented further reduction.

Twelve modified flake tools were found at the Brennan Site; ten from the plow zone, and two from sub-plow zone contexts (Figure 15). All of the flake tools have been unifacially reworked to a small degree. Four of the twelve have been utilized in two places (Figure 15-F, G, J, K) and one of these (Figure 15-G) is a multipurpose tool with both a cutting edge and a graver tip. The remainder of the flake tools show wear on only one edge. They are all made of jasper, and all show moderate wear, except one which shows heavy wear (Figure 15-E).

Four of the flake tools appear to be special purpose implements (Figure 15-I, J, K, L). Each of the tools has had a single flake removed from a lateral edge of the dorsal surface, creating a small concavity or notch which was then utilized. The wear visible on the notches is moderate, and all of the flakes are small in diameter (3 to 4 mm). Two of the flakes (Figure 15-J, K) also show evidence of edge wear but it is likely that this wear is not the cause of the wear visible in the notch. Tringham et al. (1974:180) show an experimental flake with an edge worn from cutting in a longitudinal direction, which is similar to the wear on the notched flakes at the Brennan Site. The experimental flake also has a concavity or notch along the utilized edge, but there is no wear in the concavity.

FIGURE 15

Flake Tools

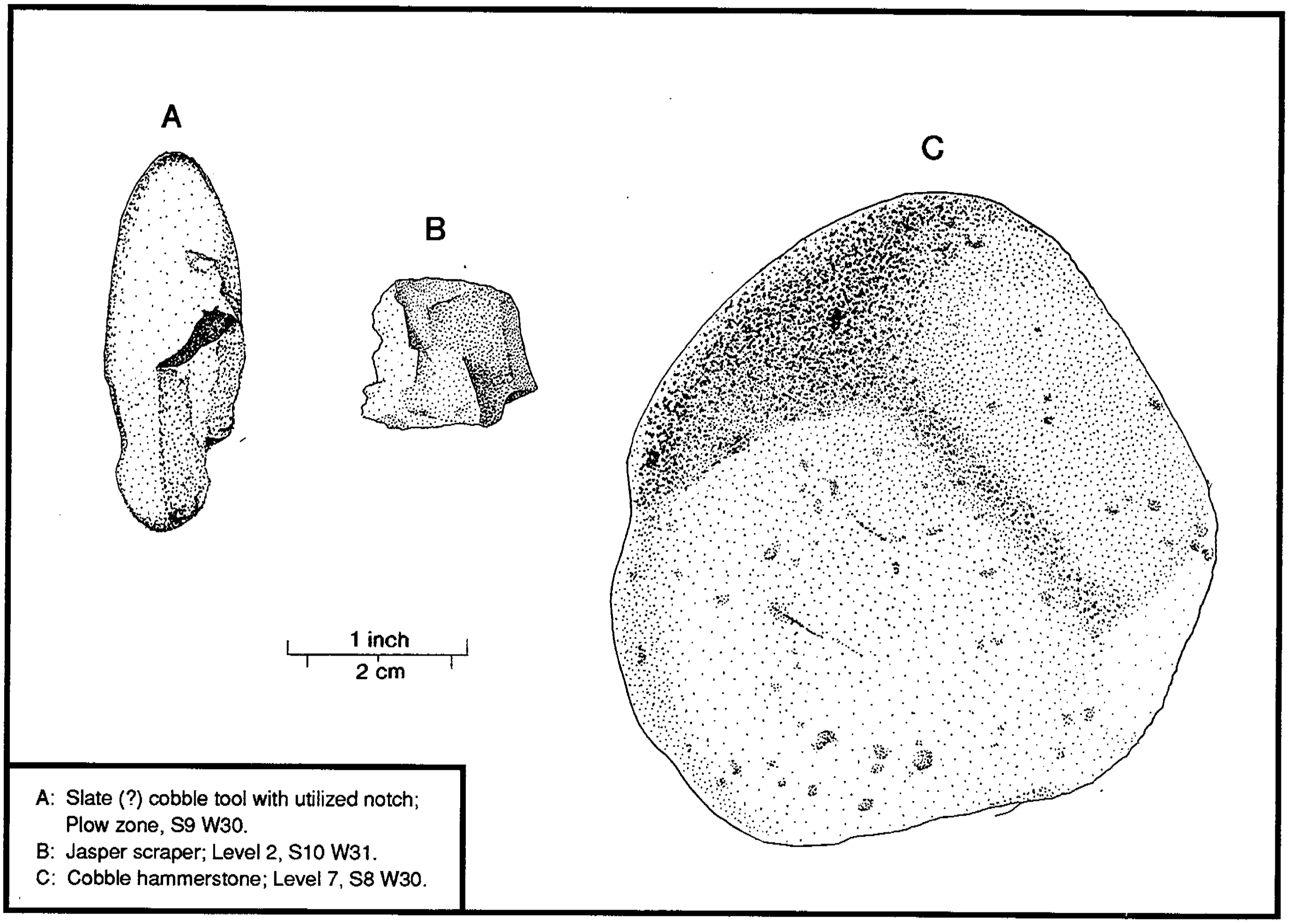


A: Plow zone, S7 W32.
B: Plow zone, S12 W30.
C: Level 3, S15 W25.
D: Level 4, S9 W30.
E: Plow zone, S7 W32.
F: Plow zone, S11 W26.
G: Possible graver; Plow zone, S12 W3.
H: Plow zone, S15 W33.
I: Plow zone, S9 W31.
J: Notched; Plow zone, S9 W30.
K: Notched; Plow zone, S9 W25.
L: Notched; Plow zone, S10 W30.

Note: All the flake tools are jasper.

FIGURE 16

Miscellaneous Stone Tools



A: Slate (?) cobble tool with utilized notch; Plow zone, S9 W30.
B: Jasper scraper; Level 2, S10 W31.
C: Cobble hammerstone; Level 7, S8 W30.

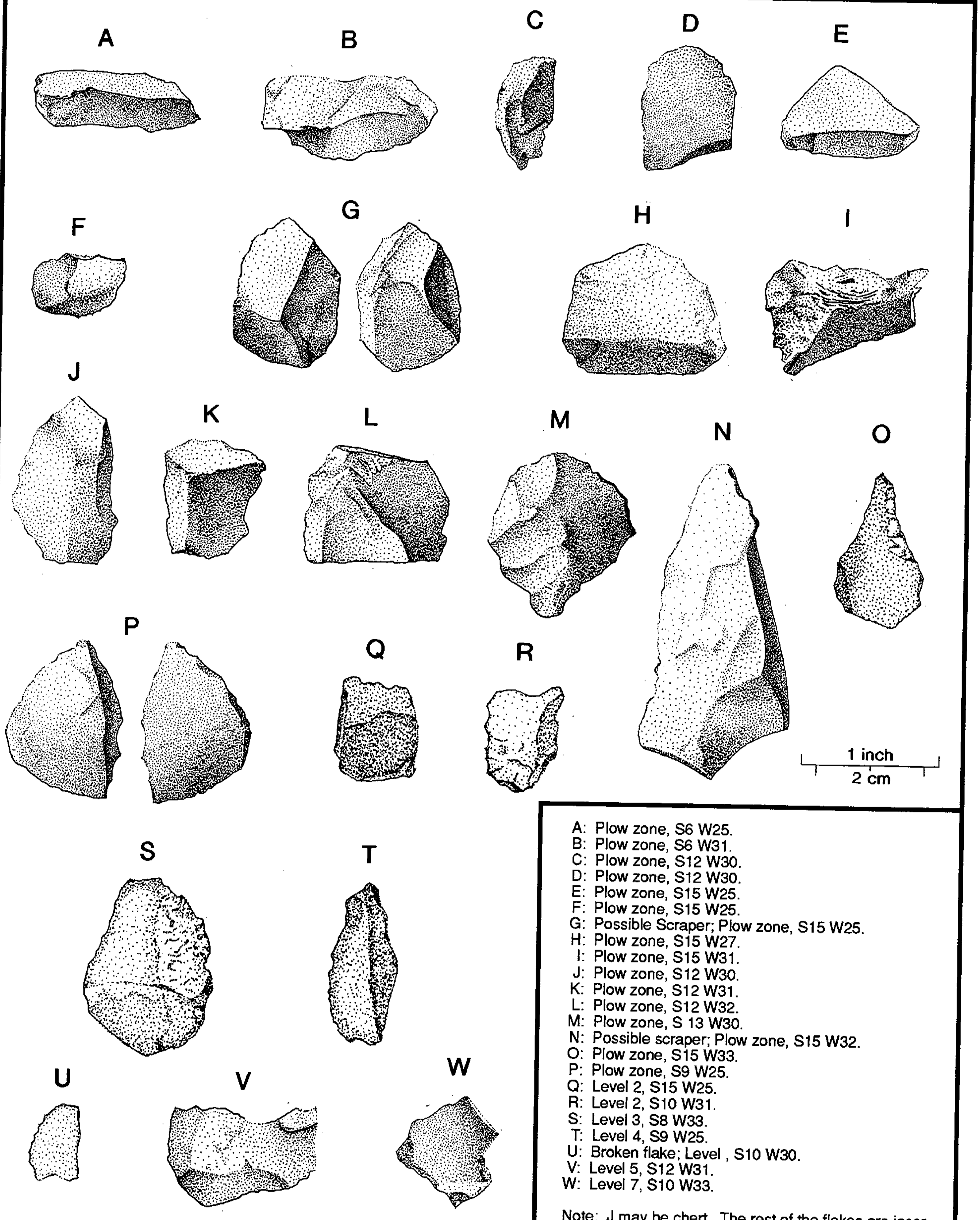
A larger, worn utilized notch appears on the single cobble tool found at the site (Figure 16-A). The cobble is small (5 cm long) and is made of slate. One jasper scraper was also recovered; it is blocky, unifacially worked, and shows light, medium, and heavy wear on three sides respectively (Figure 16-B). The steep edge angle and amount of wear on the scraper is characteristic of use on hard material such as bone or wood (Wilmsen 1970:71; Odell 1980:411).

Unmodified, utilized flakes comprise the largest single class of tools at the Brennan Site; the 24 recovered represent 55% of all tools, and 1% of the total amount of debitage (Figure 17). All of the utilized flakes are made of jasper, and most show light to moderate wear.

Three jasper cores were found during Phase III excavations at the Brennan Site (Figure 18). All of the cores appear exhausted, two because of inclusions in the raw material (Figure 18-A, B) and one because of small size (Figure 18-C). Also illustrated is a larger jasper core found

FIGURE 17

Utilized Flakes

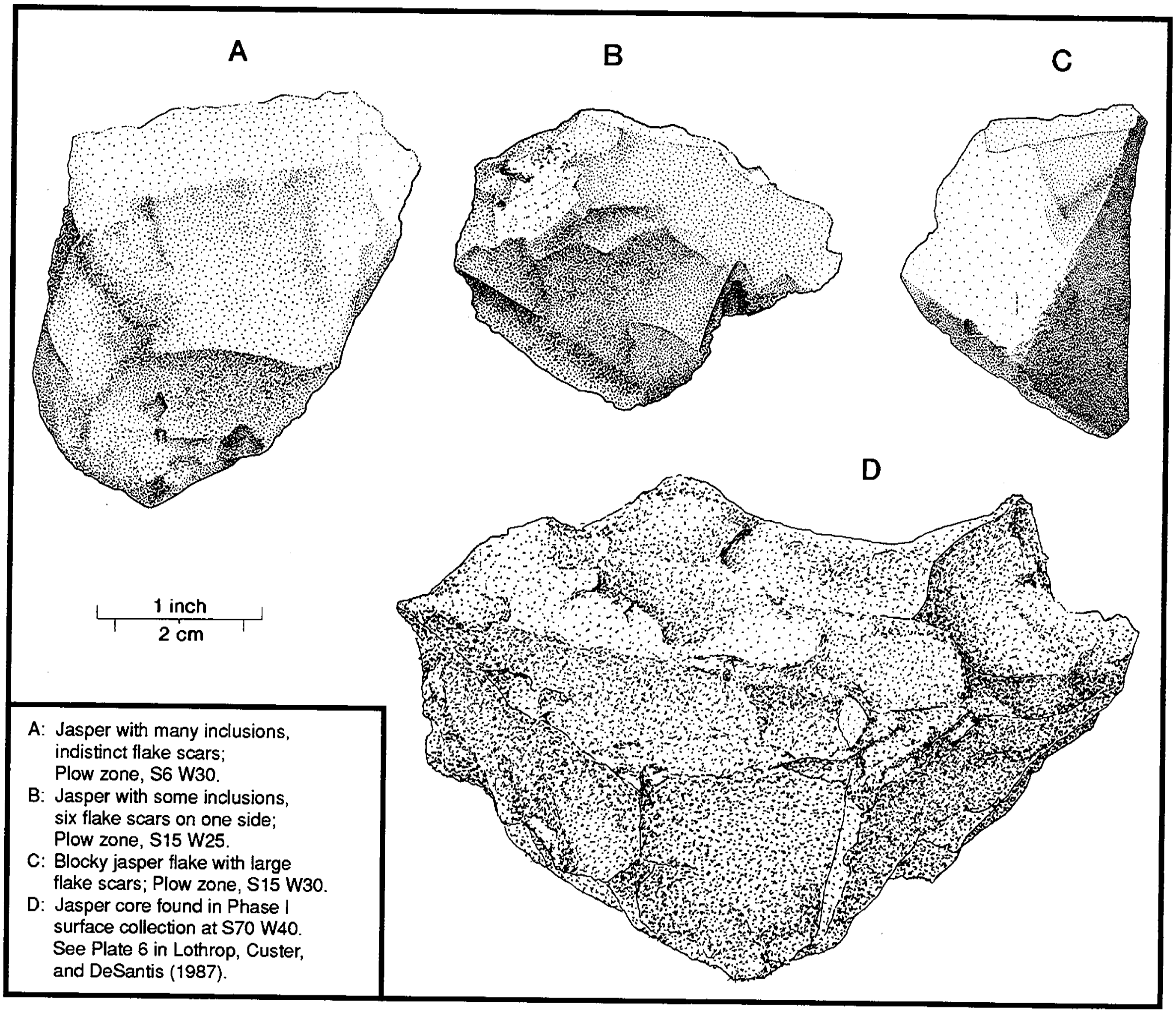


A: Plow zone, S6 W25.
B: Plow zone, S6 W31.
C: Plow zone, S12 W30.
D: Plow zone, S12 W30.
E: Plow zone, S15 W25.
F: Plow zone, S15 W25.
G: Possible Scraper; Plow zone, S15 W25.
H: Plow zone, S15 W27.
I: Plow zone, S15 W31.
J: Plow zone, S12 W30.
K: Plow zone, S12 W31.
L: Plow zone, S12 W32.
M: Plow zone, S 13 W30.
N: Possible scraper; Plow zone, S15 W32.
O: Plow zone, S15 W33.
P: Plow zone, S9 W25.
Q: Level 2, S15 W25.
R: Level 2, S10 W31.
S: Level 3, S8 W33.
T: Level 4, S9 W25.
U: Broken flake; Level , S10 W30.
V: Level 5, S12 W31.
W: Level 7, S10 W33.

Note: J may be chert. The rest of the flakes are jaser.

FIGURE 18

Cores



A: Jasper with many inclusions, indistinct flake scars; Plow zone, S6 W30.
B: Jasper with some inclusions, six flake scars on one side; Plow zone, S15 W25.
C: Blocky jasper flake with large flake scars; Plow zone, S15 W30.
D: Jasper core found in Phase I surface collection at S70 W40. See Plate 6 in Lothrop, Custer, and DeSantis (1987).

during the Phase II controlled surface collection (Figure 18-D). This core, which weighs 475 grams, was most likely derived from a large primary flake produced at a quarry site, although clear evidence has been obscured by the later removal of flakes. Flake scars appear on two of the four faces of the core from which flakes could have been removed. Although the core does not appear to have been completely exhausted, inclusions in the jasper have limited the amount of potential flakes remaining. There are no signs of prepared platforms on the core.

TABLE 6

Flake Attribute Analysis Results for the Brennan Site

Flake type		**Size**		**Platform shape**		**Platform preparation**	
Complete	67	<2 cm	108	Triangular	42	Present	13
Proximal	43	2-5 cm	85	Flat	28	Absent	95
Medial	45	>5 cm	7	Round	38	No observation	92
Distal	45			No observation	92		
		Scar count				**Directions count**	
Cortex		Mean	= 1.78	**Remnant biface edge**		Mean	= 1.51
Present	0	Standard deviation	= 0.78	Present	5	Standard deviation	=0.70
Absent	200			Absent	195		

Note: This table is based on a sample of 200 flakes

A flake attribute analysis based on the work of Verrey (1986), Magne (1981, 1985), and Gunn and Mahula (1977) and designed to indicate whether debitage derived from bifaces or from cores was conducted on a random sample of 200 unmodified flakes from the Brennan Site assemblage (Table 6). A summary of the results is given below. More detailed discussion of the flake attribute analysis is given in the conclusions.

The high percentage of broken flakes in the sample (66%) suggests biface reduction. There was a total absence of cortex on the sample flakes indicating that they were not derived from cobble cores. The majority of flakes (54%) were quite small indicating that they were not derived from either large early stage bifaces or large cores; however, a significant percentage (43%) were medium sized indicating that they could have resulted from later stages of biface reduction. The mean flake scar count is 1.78 with a standard deviation of 0.78. Unfortunately, this value is not indicative of either biface or core reduction. On the other hand, the mean directional count of 1.51 is more typical of biface reduction than it is of core reduction. Triangular platforms, associated with biface reduction, were present on 21% of the flakes; round platforms, associated with early stages of biface reduction, were present on 19% of the flakes; and flat platforms, associated with core reduction, were present on 14% of the sample. Remnant biface edges were present on 3% of the sample flakes. Platform preparation, which is more typical of biface than of core reduction, is present on 7% of the sample flakes. In sum, the analysis of the flake assemblage indicates that much of the debitage and most flake blanks used to produce tools were derived from biface reduction, although a significant degree of core reduction is also indicated. Results of the flake attribute analysis suggest that both bifaces and cores were being reduced at the site and both played important roles in filling the lithic needs of the site's occupants.

The presence of small microflakes in flotation samples indicates that the resharpening of tools manufactured from quartz, quartzite, and chert, as well as jasper, took place at the Brennan Site (Table 5). It is interesting to note that the relative amounts of non-jasper microdebitage are somewhat higher than for general debitage. This may be an indication that finished tools made of these materials, which had been manufactured elsewhere, were being refurbished while new jasper tools were being produced.

TABLE 7

Cortex Frequencies on Raw Materials

	Jasper	Quartzite	Chalcedony	Quartz	Chert	Other	Total
Number	1890(13)	11(5)	10	7(2)	2(1)	2(1)	1922(22)
Percent with Cortex	<1%	45%	0%	29%	50%	50%	1%

The source of the raw material for the tools and debitage at the Brennan Site is the primary outcrops of high quality cryptocrystalline stone in the vicinity of Iron Hill, Delaware and northeastern Cecil County, Maryland. These outcrops, traditionally referred to as the " Delaware Chalcedony Complex," have been a focus of prehistoric lithic procurement from Paleo-Indian through Woodland II times (Wilkens 1976; Custer and Galasso 1980; Custer 1980, 1983; Custer, Ward, and Watson 1986). Although it is not possible to state with absolute certainty that the jasper recovered at the Brennan Site came from the Delaware Chalcedony Complex outcrops, there are at least two reasons for believing so. The first reason concerns the geological source from which the jasper at the site originated. The nearly total absence of cortex on jasper artifacts from the site (Table 7) indicates that the material came from a primary source and not from secondary cobble deposits. Outcrops of the Delaware Chalcedony Complex are the nearest source of primary jaspers (8 km to the north); the next closest source of primary jasper is approximately 100 km to the north.

The second reason concerns the characteristics of the jasper itself. The jasper used for artifacts at the Brennan Site is fairly uniform in color, texture, and the amount and type of inclusion. While it has been argued that macroscopic inspection of jasper is insufficient to determine particular quarry sources, jasper with the same physical characteristics as the jasper at the Brennan Site has been observed at outcrops of the Delaware Chalcedony Complex (Custer, Ward, and Watson 1986). The physical uniformity of the jasper at the Brennan Site also indicates a primary source: jasper derived from cobbles would probably be more variable.

The color of jasper from the Delaware Chalcedony Complex ranges from brown to yellow to red, and is determined by the chemical variability of the material. The jasper found at the Brennan Site almost uniformly red in color. The red color in jaspers can result from recrystallization of minerals from exposure to heat, but this does not seem to be the case for the material from the Brennan Site. Hatch and Miller (1985) tested samples of jasper debitage from various locations at the Vera Cruz jasper quarry in Lehigh County, Pennsylvania for evidence of heat treatment. The highest percentage of thermally-altered flakes from various stages of biface reduction, was 81.1%. However, over 93% of Hatch and Miller's (1985) samples showed less than 50% reddening from heat treatment. In contrast, at the Brennan Site nearly 100% of the flakes are red. In addition, none of the other characteristics of thermal alteration, such as microcracking or "potlidding", are visible in the jasper from the Brennan Site. It is therefore likely that the color of the flakes at the site is a function of their chemical make-up, and not a result of heat treatment.

Unutilized debitage at the Brennan Site is the product of biface reduction and the reduction of cores. Jasper flakes accounted for 98% of the total amount of debitage recovered, with the remaining 2% being composed of small amounts of quartzite, chalcedony, quartz, and chert (Table 2). Specifically, the jasper flakes resulted from the reduction of early stage bifaces, and the possible manufacture and resharpening of projectile points. They also derived from the reduction of jasper cores, most likely for the production of flakes for use as tools. The presence of small amounts of non-jasper debitage indicates that these other materials, which probably derived from cobbles, were also being utilized to a small degree. However, the absence of tools made from these materials makes it difficult to identify the end product of their reduction.

The majority of bifaces recovered during Phase II and Phase III excavations were early stage forms which were rejected during the process of reduction. The morphology of some of the larger, intact bifaces suggests that they arrived at the site in the form of prepared bifaces made from large primary flakes. While at the site, the bifaces were further reduced to some degree, possibly into projectile points made to replace broken points culled from the group's tool kits. The two broken points found during Phase II excavations, and the fractured late stage biface found during final data recovery, are probably examples of discarded tools. The number of discarded late stage bifaces and projectile points is low, however, which suggests that bifacial tool manufacture and replacement was not performed on a large scale. This supposition is also supported by the small number of bifaces that were rejected in the later stages of manufacture. Only two late stage biface rejects were found during Phase I and II field work; none were found during Phase III excavations.

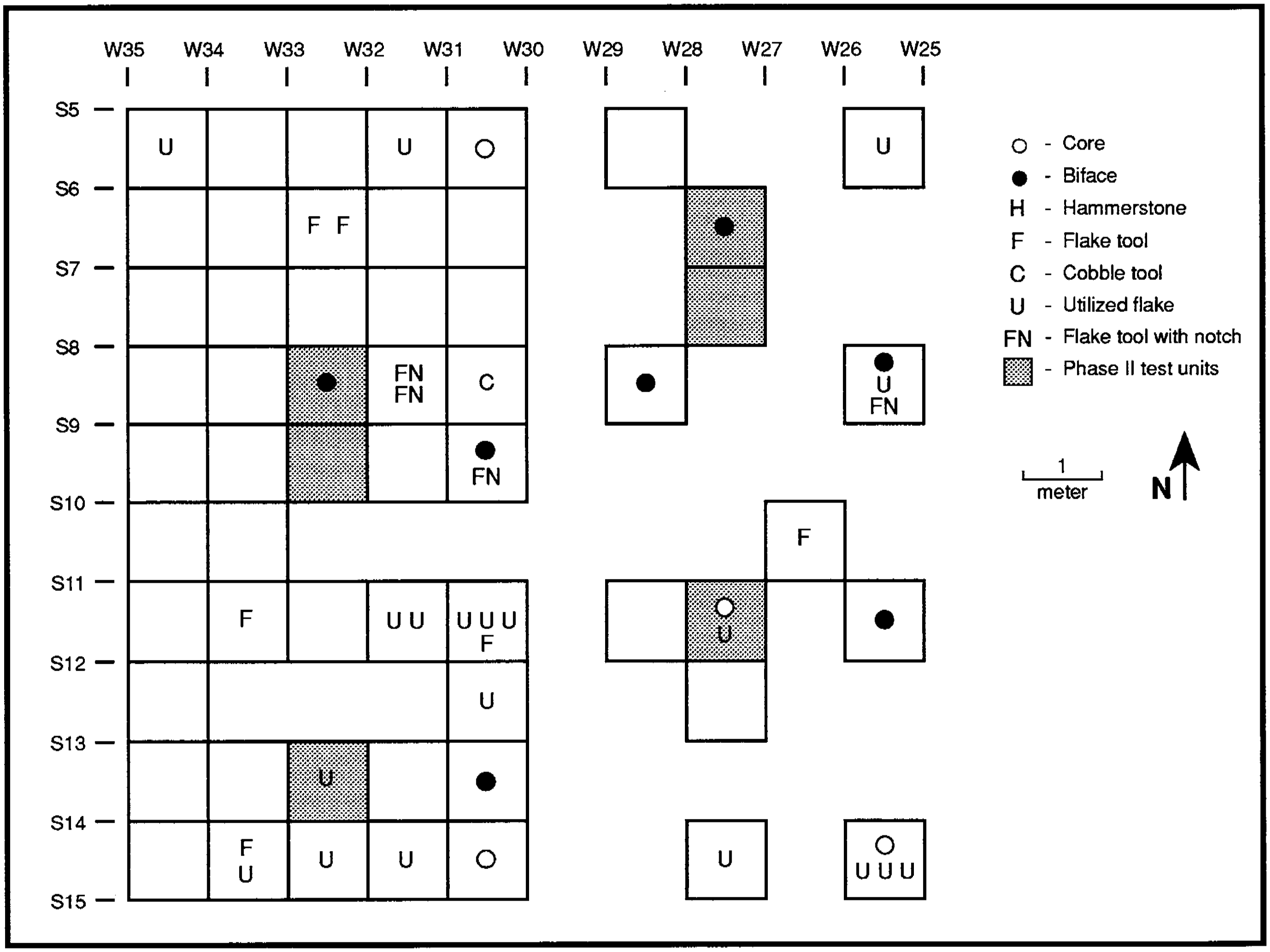
Other sites in the area near the Delaware Chalcedony Complex — both larger than (7NC-D-3, 7NC-D-5) and of a similar size (7NC-D-19) to the Brennan Site — have a much higher numbers of both early and late stage rejected bifaces, as well as discarded tools (Custer, Ward, and Watson 1986). Systematic, controlled excavations have not been performed at most jasper reduction sites in and around the Delaware Chalcedony Complex, so direct comparisons between sites for the occurrence of various artifact types are not possible. However, examination of uncontrolled surface collections from sites within 2-3 km of the jasper outcrops indicates that the reduction of primary bifaces into both later stage bifaces and finished tools took place to a greater degree than found at the Brennan Site.

Jasper cores were brought to the Brennan Site, probably in a quickly prepared, amorphous form and were reduced to produce flakes. The cores are the likely source of the utilized flakes and modified flake tools found during Phase II and III excavations. It is also possible that the cores themselves were later bifacially worked into tools.

The large numbers of flake tools and utilized flakes at the site gives some indication of the additional activities taking place. Food preparation operations, such as butchering or animal processing, are suggested, but the absence of tools used in the initial stages of butchering indicates

FIGURE 19

Distribution of Tools, Level 1, Plow Zone

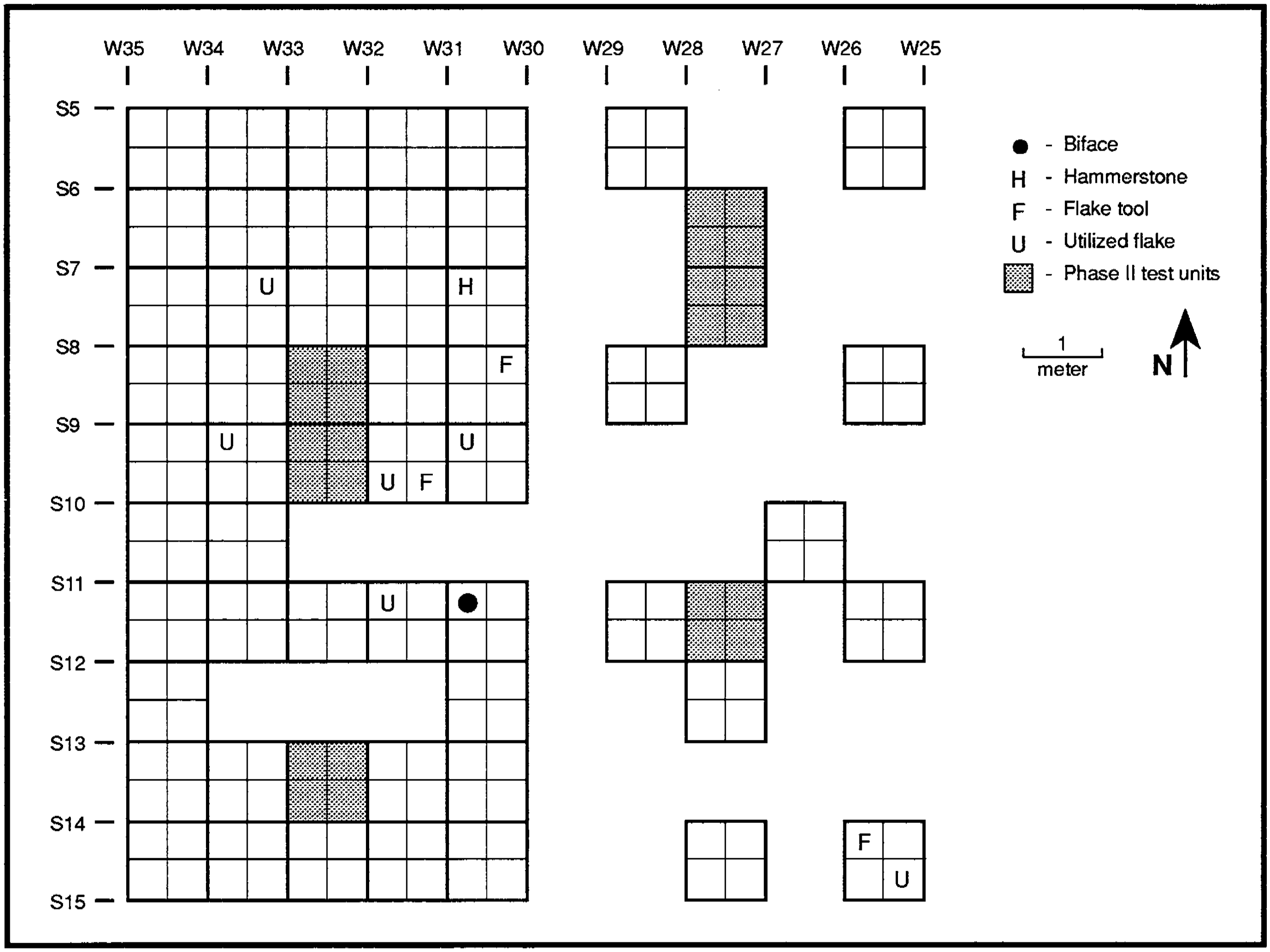


that butchering was carried out elsewhere. Only secondary cutting and slicing operations were performed at the Brennan Site. The small amount of wear on most tools indicates that they were expediently used, as might be expected in a situation where high quality raw materials were readily available. Only one multi-purpose flake tool was found — further evidence that tools were not heavily curated.

Flake tools and utilized flakes may have also been involved in the manufacture of non-lithic tools. In particular, the four notched flake tools and the notched cobble tool could have been used to produce other tools of bone or wood, such as awls or needles. The jasper scraper recovered from the site may also have been used on bone or wood.

FIGURE 20

Distribution of Tools, Level 2, Below Plow Zone



The rejected bifaces, cores, and large amounts of debitage found at the Brennan Site indicate that stone tool manufacturing was a major activity of the group or groups which inhabited it. The presence of other types of tools indicates that other activities took place there as well. In sum, the major activity taking place at the Brennan Site was the reduction of bifaces and cores into replacement and expedient tools. Groups came to the site with prepared early stage bifaces and cores transported from nearby primary jasper outcrops of the Delaware Chalcedony Complex. The bifaces were then reduced into later stage bifaces and finished tools, sometimes unsuccessfully. Some exhausted and broken tools were discarded, and existing tools were refurbished. Flakes were produced from the cores, and were then used in animal and plant food processing. The presence of charred seeds in flotation samples may also indicate the use of plant foods, but this cannot be stated with certainty. The small amount of fire-cracked rock found at the site may indicate the use of fire in any of the activities in practice at the Brennan Site.

Activity Areas

In order to delineate any horizontal artifact clustering, the spatial distributions of various artifact classes (tools, debitage, and fire-cracked rocks) were mapped using each 1 m sq. excavation block as a minimum provenience unit for plow zone soils, and each 50 cm sq. block for sub-plow zone soils. As mentioned in the section on site stratigraphy, movement of artifacts through the profile has been demonstrated. Therefore, artifacts from all levels below the plow zone (Level 1), have been combined into one sub-plow zone sample.

The low numbers of tools, fire-cracked rocks, and non-jasper debitage allowed distribution maps for these classes of artifacts to be created by hand. Distribution maps for jasper flakes were made using the Surfer Program by Golden Software, with a horizontal smoothing factor of 0.9 (a smoothing factor of 1.0 = no smoothing, a factor of 0.0 = total smoothing). Artifacts from Phase II units which fell within the Phase III excavation area are included in the distribution maps.

Figures 19 and 20 show the location of all tools recovered from plow zone and sub-plow zone contexts at the Brennan Site. All of the different tool types present in the assemblage can be found in various parts of the site, but some degree of horizontal separation is evident. Bifaces and biface fragments appear more frequently in the north half of the site (i.e., north of the South 10 line) while utilized flakes and cores are located more to the south. While caution must be used when considering the spatial patterning of plow disturbed and/or naturally disturbed artifacts, it still appears that biface reduction activities were taking place in one area, while the production of flakes from cores, and the activities associated with utilized flakes, were taking place in another.

One small concentration of a particular type of flake tool is also of note. Three of the four flake tools with "notches," (discussed earlier in the report) are located in adjacent units (S9 W31 and S10 W30). In addition, a notched cobble tool was recovered from a third adjacent unit (S9 W30). The activity associated with these unusual tools appears to have taken place in one small area of the site.

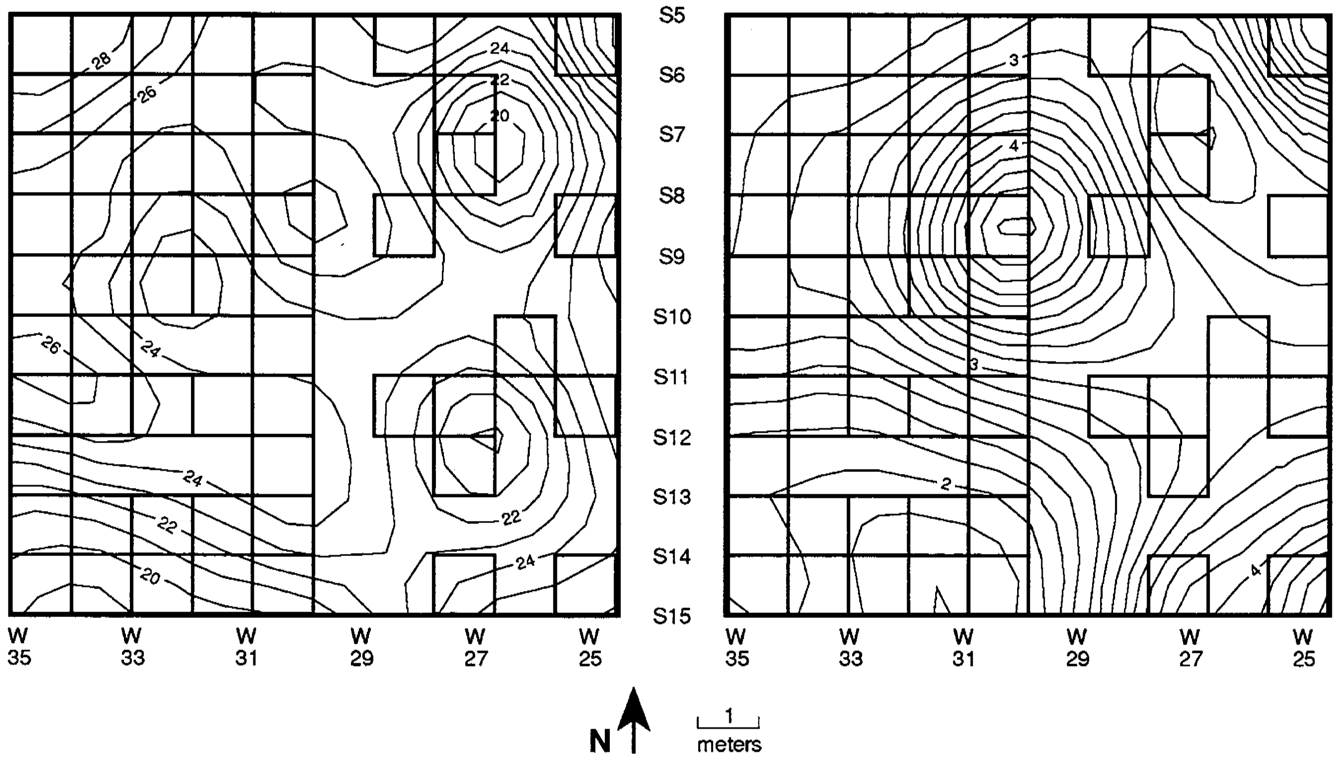
Figures 21 and 22 show the distribution of jasper debitage from plow zone and sub-plow zone soils. As may be seen, jasper flakes in the plow zone are located across the entire site, with some greater amounts in the north half and along the eastern edge of the excavation area. Jasper flakes from below the plow zone generally conform to this pattern, and show a conspicuous concentration around S8.5 W30. It is likely that the reduction of bifaces to create tools produces more flakes than does the reduction of a core to produce flakes, in which the flakes themselves are the desired product. The higher incidence of jasper debitage in the north half of the site therefore corresponds with the activity of biface reduction previously noted. Conversely, the lower but still substantial amount of debitage in the south half reflects the reduction of jasper cores taking place there.

FIGURE 21

Distribution of Jasper Flakes, Level 1, Plow Zone

FIGURE 22

Distribution of Jasper Flakes, Level 2, Below the Plow Zone



The locations of debitage made from raw materials other than jasper are shown in Figures 23 and 24. The number of flakes is small, and they are widely dispersed across the site. A modest concentration of flakes of various materials appears in the southwest corner of the plow zone soils (Figure 23). Sub-plow zone excavations also found a small concentration; seven quartzite flakes were found in the unit S15 W25 (Figure 24). The quartzite flakes have a high percentage of cortex, and refit to one another. They were removed from a flat, tabular cobble, and probably represent a single episode of quartzite cobble reduction.

Figures 25 and 26 are the distribution maps for all artifacts with cortex from the plow zone and sub-plow zone soils. The numbers are small, and like the non-jasper debitage (which accounts for 39% of flakes with cortex) they are widely distributed across the site; no concentrations are present.

Two small concentrations of fire-cracked rock occur below the plow zone (Figure 27). The first is located in Unit S9 W30, and consists of nine rocks. No charcoal or stained earth was associated with the fire-cracked rock. The second location consists of the two fire-cracked rocks found in units S15 W30 and S15 W31. Like the other concentration, no charcoal or stained earth was found. A small amount of fire-cracked rock was also found in the plow zone

FIGURE 23

Distribution of Non-Jasper Flakes, Level 1, Plow Zone

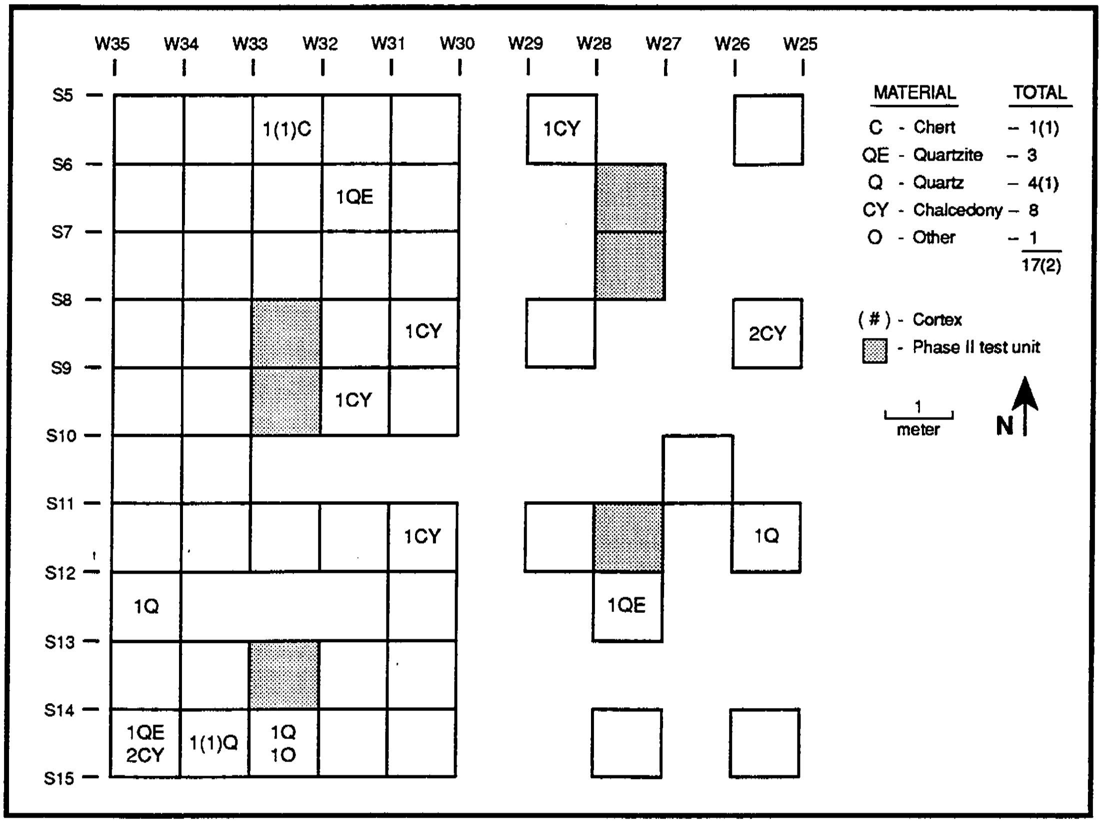


FIGURE 24

Distribution of Non-Jasper Flakes, Level 2, Below Plow Zone

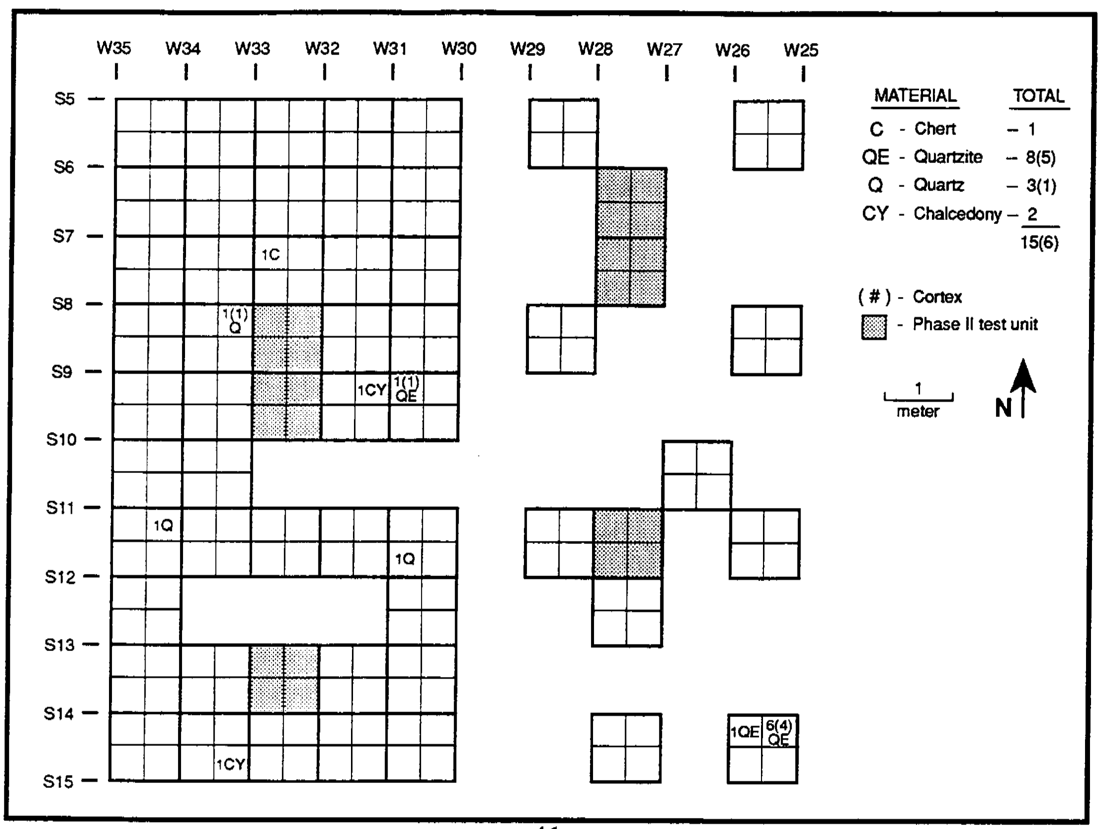


FIGURE 25

Distribution of All Flakes with Cortex, Level 1, Plow Zone

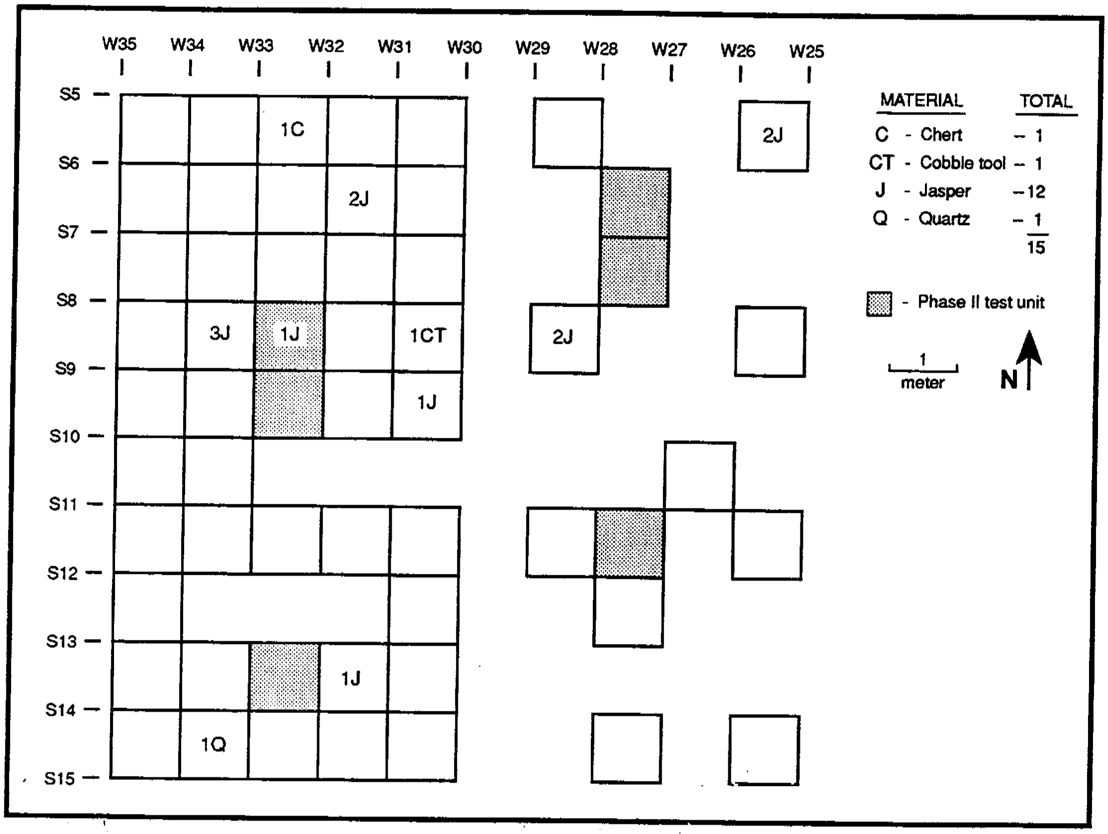


FIGURE 26

Distribution of All Flakes with Cortex, Level 2, Below Plow Zone

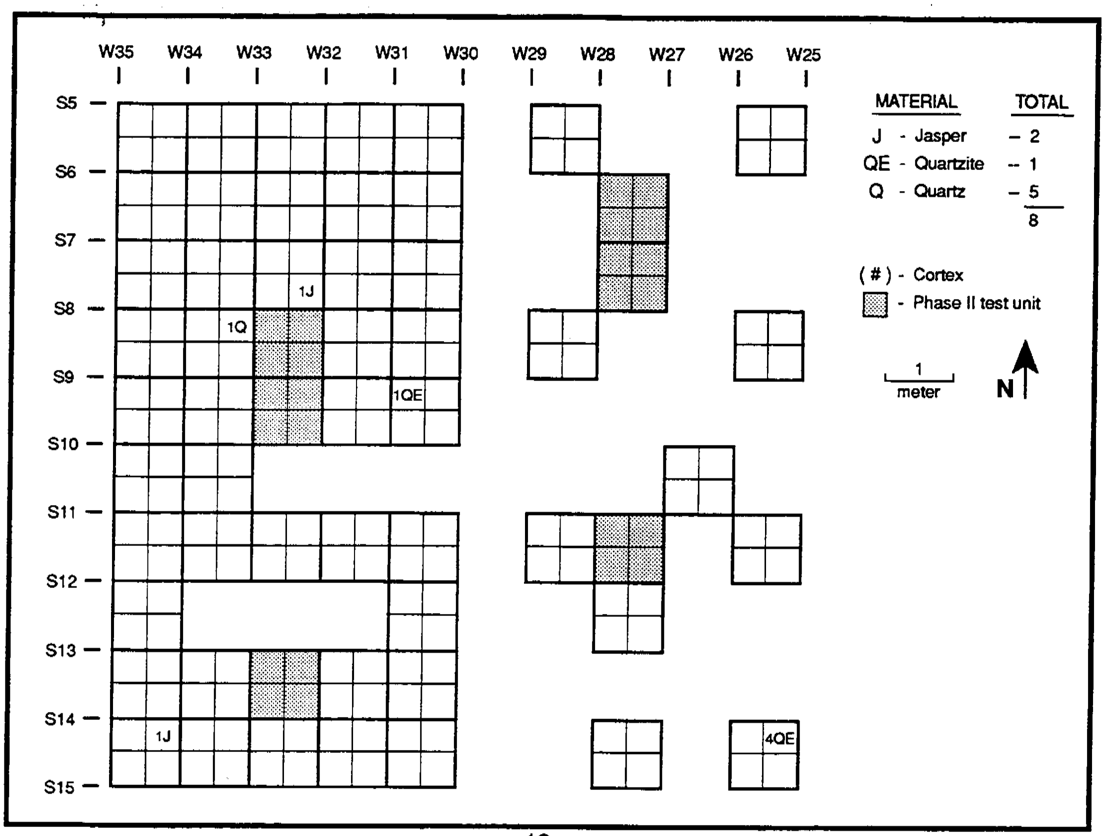
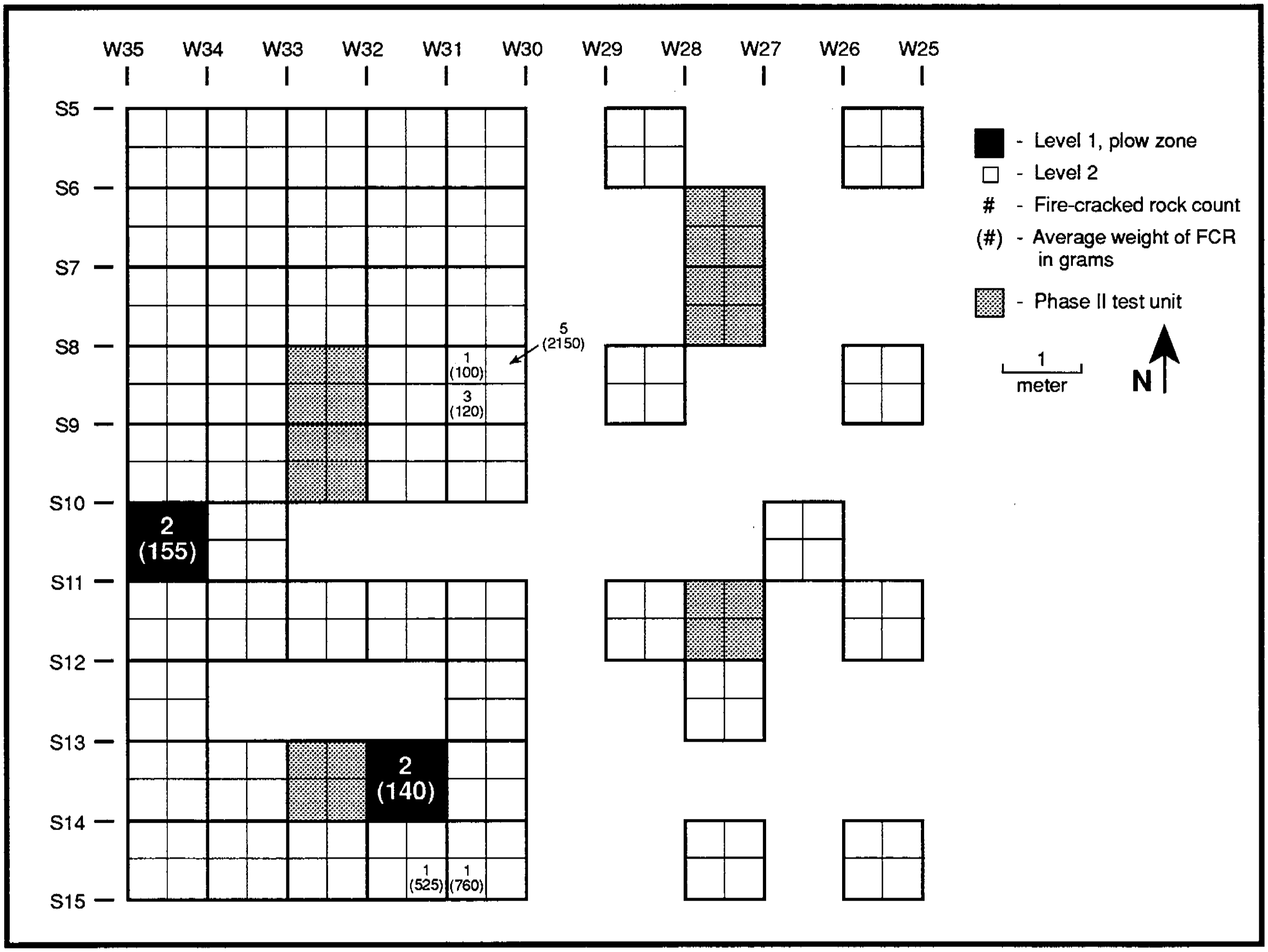


FIGURE 27
Distribution of Fire-Cracked Rock



(Figure 27). The larger collection of fire-cracked rocks in the northern half of the site is the likely location of a hearth. The two fire-cracked rocks further south may represent a second hearth, outside of the excavation area. The small amount of fire-cracked rocks found in the plow zone may have been displaced by plowing from either of the two sub-plow zone locations, or may be from a third disturbed hearth.

Two broadly defined activity areas may be identified at the Brennan Site. In the northern half of the site, jasper biface reduction took place, which produced large amounts of jasper debitage, and a smaller number of rejected bifaces. The vast majority of the jasper is from a primary source, but the presence of non-jasper debitage, as well as jasper and non-jasper flakes with cortex, suggests that a very small number of cobbles or bifaces produced from cobbles were also reduced there. A small number of utilized flakes and flake tools were recovered from the north half, indicating that activities such as plant or animal processing, or the manufacture of non-stone tools, took place, to a limited degree. The small possible hearth located in the north half of the site may have been used in processing activities, or for warmth. One apparently specialized but unknown activity also took place in this area, utilizing flakes with small notches.

The south half of the site is characterized by smaller numbers of flakes, but a higher incidence of cores and utilized flakes. Activities in the area were probably more domestic, involving the processing of animal and/or plant resources, and possibly cooking. It is likely that the primary jasper cores found here were the source of the expediently utilized flakes. A very small number of cobbles may also have been worked in this area, and a limited amount of jasper biface reduction may have taken place as well.

DISCUSSION AND CONCLUSIONS

The artifact assemblages and their distributions indicate that the Brennan Site functioned as a transient procurement site where the secondary reduction of jasper bifaces was the primary activity. Furthermore, the occupation of the Brennan Site appears to have been associated with quarrying activities at the Delaware Chalcedony Complex (Custer, Ward, and Watson 1986). The stone tool kit is quite limited and is composed primarily of early stage biface rejects, flake tools, and utilized flakes. One late stage biface was also present in the assemblage and two discarded projectile points were recovered in Phase II excavations. The dominant artifact class in the assemblage is waste flakes resulting from the reduction of jasper bifaces and cores. Some edge sharpening also appears to have taken place at the site, as well as a small degree of processing activity. The occupation of the site was long enough to warrant the construction of a hearth, but no evidence of structures was found. The presence of the Brennan Site secondary lithic reduction station at an anomalously large distance from a quarry source has implications for regional settlement patterns and the organization of lithic technologies during the Woodland I Period.

Regional Lithic Technologies

The Brennan Site can be compared with other sites in the Fall Line and High Coastal Plain. Table 8 shows the percentage of cortex and raw material use among a variety of Woodland I lithic assemblages, and Figure 28 shows the locations of the sites from which these assemblages were derived. Due to the various sizes of the artifact assemblages, a difference-of-proportion test (Parsons 1974) was applied to compare the sites listed in Table 8. Although samples from some of the sites are quite small, they can nevertheless be compared with the other sites using the difference-of-proportion test.

Table 9 lists the sites in rank order by percentage frequencies of cortex, cryptocrystalline use, and quartzite and quartz use. Sites with no significant differences in percentages are joined by brackets. Table 9 was prepared from a subset of site comparisons generated in an earlier report (Catts, Hodny, and Custer 1989) to which the Brennan Site was added.

TABLE 8

Comparative Lithic Resource Use for Northwestern Delaware

Site	Function	Total Artifacts	Cortex %	Cryptocrystalline %	Quartzite/ Quartz %	References
7NC-F-61A	Quarry Reduction	1,922	1	99	1	this report
7NC-D-129	Procurement	2,073	6	75	24	Custer, Watson, Hoseth, and Coleman 1988
7NC-E-46	Hunting/ Staging	10,512	20	22	69	Custer and Bachman 1984
7NC-D-54	Cobble Reduction Base Camp	1,288	28	32	59	Custer, Sprinkle, Flora, and Stiner 1981
7NC-D-55A	Cobble Reduction Base Camp	132	45	16	69	Custer, Sprinkle, Flora, and Stiner 1981
7NC-D-55B	Cobble Reduction Base Camp	2,304	29	8	88	Custer, Sprinkle, Flora, and Stiner 1981
7NC-E-6A Area 2A	Macro-band Base Camp	5,515	9	61	33	Custer 1982
7NC-E-6A Area 2B	Macro-band Base Camp	6,206	9	80	23	Custer 1982
7NC-D-5	Quarry Reduction	94	0	60	32	Custer, Ward, and Watson 1986
7NC-D-3	Quarry Reduction	368	0	51	38	Custer, Ward, and Watson 1986
7NC-D-19	Quarry Reduction	653	0	74	26	Custer, Ward, and Watson 1986

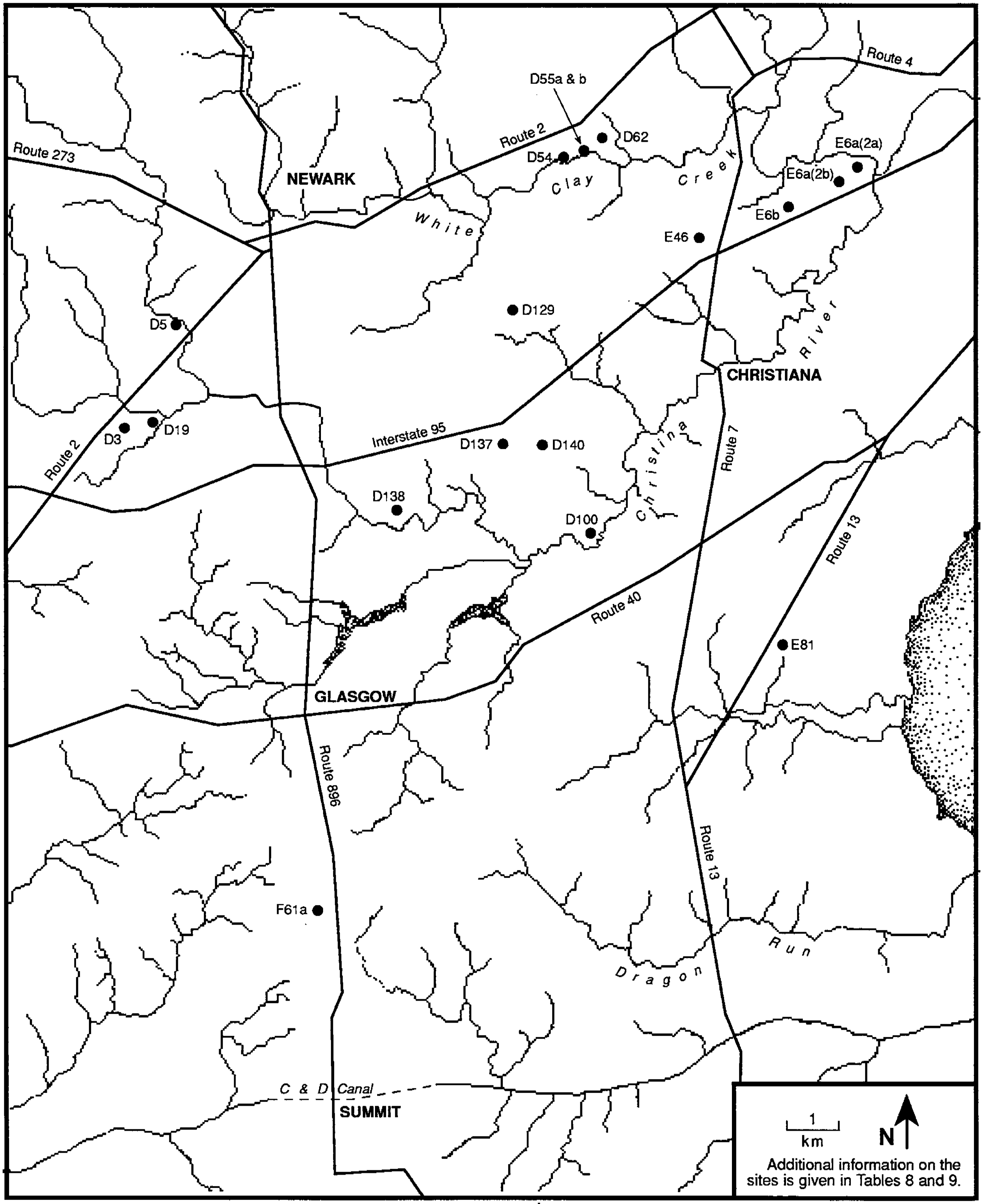
TABLE 9

Summary of Lithic Resource Use Patterns for Northwestern Delaware

Cortex		Cryptocrystalline		Quartzite/ Quartz ratio	
7NC-D-5	Quarry Reduction-0%	7NC-D-55B	Cobble Reduction Base Camp-8%	7NC-F-61A	Quarry Reduction-1%
7NC-D-3	Quarry Reduction-0%	7NC-D-55A	Cobble Reduction Base Camp-16%	7NC-E-6A(2B)	Macro-band Base Camp-23%
7NC-D-19	Quarry Reduction-0%	7NC-E-46	Hunting/ Staging-22%	7NC-D-129	Procurement-24%
7NC-F-61A	Quarry Reduction-1%	7NC-D-54	Cobble Reduction Base Camp-32%	7NC-D-19	Quarry Reduction-26%
7NC-D-129	Procurement-6%	7NC-D-3	Quarry Reduction-51%	7NC-D-5	Quarry Reduction-32%
7NC-E-61(2A)	Macro-band Base Camp-9%	7NC-D-5	Quarry Reduction-60%	7NC-E-6A(2A)	Macro-band Base Camp-33%
7NC-E-6A(2B)	Macro-band Base Camp-9%	7NC-E-6A(2A)	Macro-band Base Camp-61%	7NC-D-3	Quarry Reduction-38%
7NC-E-46	Hunting/ Staging-20%	7NC-D-19	Quarry Reduction-74%	7NC-D-54	Cobble Reduction Base Camp-59%
7NC-D-54	Cobble Reduction Base Camp-28%	7NC-D-129	Procurement-75%	7NC-D-55A	Cobble Reduction Base Camp-69%
7NC-D-55B	Cobble Reduction Base Camp-29%	7NC-E-6A(2B)	Macro-band Base Camp-80%	7NC-E-46	Hunting/ Staging-69%
7NC-D-55A	Cobble Reduction Base Camp-45%	7NC-F-61A	Quarry Reduction-99%	7NC-D-55B	Cobble Reduction Base Camp-88%

FIGURE 28

Locations of Archaeological Sites used for Lithic Assemblage Comparisons



For cortex percentage, which is an indicator of cobble resource use, the Brennan Site is grouped with three other Delaware Chalcedony Complex quarry reduction sites (7NC-D-3, 7NC-D-5, and 7NC-D-19). No cortex was present on lithic artifacts in the assemblages from these four sites. For cryptocrystalline stone usage, the Brennan Site ranks highest, and the percentage of cryptocrystalline use at the Brennan Site is significantly different from the next highest ranking site — Site 7NC-E-6A, Area 2B. Quartzite and quartz usage at the Brennan Site ranks lowest among all the sites and is again significantly different from the site closest in the rankings, again — Site 7NC-E-6A, Area 2B. The quarry reduction assemblages are from surface collections; therefore, debitage is probably under-represented. Indeed, the collection from 7NC-D-5 (Custer, Ward, and Watson 1986) contains no flakes at all. The Brennan Site assemblage, on the other hand, is 98% debitage.

The Brennan Site's grouping with other quarry reduction sites of the Delaware Chalcedony Complex is understandable, but the incidence of cryptocrystalline materials in the assemblage is puzzling. Cryptocrystalline materials are much more common at the Brennan Site, which is 8 km south of Iron Hill, than they are at quarry reduction sites located within 2 km of Iron Hill. An examination of the summary catalogues of the quarry reduction sites (7NC-D-3, 7NC-D-5, and 7NC-D-19) indicates that many of the non-cryptocrystalline tools in the assemblages were discarded points and bifaces. The discarded cryptocrystalline tools may represent items brought to the sites, but replaced with fresh tools that were then carried away from the sites.

In sum, the data suggests that primary cryptocrystalline jasper was the preferred material at the Brennan Site. Furthermore, the likely sources of the jasper were the quarries of the Delaware Chalcedony Complex at Iron and Chestnut hills.

Both bifaces and cores are present in the artifact assemblage from the Brennan Site. The use of flakes for the production of unifacial tools and a portion of the bifacial tools, as well as expedient needs, testifies to the importance of core technology at the Brennan Site. However, the presence of early stage bifaces rejected in the course of manufacture and discarded late stage bifaces, as well as a great quantity of waste flakes, indicates that the production of bifaces was also quite important at the site. An attribute analysis of the debitage recovered from the Brennan Site was undertaken in an attempt to shed more light on lithic technology practices at the site.

Flake attributes for debitage from the Brennan Site were compared to the same attributes for debitage assemblages from the Fifty Site (44WR50) and the Crane Point Site. The Fifty Site is a Late Paleo-Indian/Early Archaic hunting and processing site in the Shenandoah Valley of Virginia (Carr 1975, 1986) where primary lithic resources are readily available. The artifact assemblage from the Fifty Site was derived from cores. The Crane Point Site is a Late Paleo-Indian/Early Archaic base camp site on the Eastern Shore of Maryland (Lowery and Custer 1990) where lithic resource availability is low. The artifact assemblage from this site was derived from bifaces. Tables 6 and 10 show the distribution of attributes for a sample of 200 flakes from the Brennan Site, 100 flakes from the Fifty Site, and 50 flakes from the Crane Point Site.

TABLE 10

Flake Attribute Analysis Control Data

44WR50 site - Core Reduction

Flake type		Size		Platform shape		Platform preparation	
Complete	63	<2 cm	49	Triangular	10	Present	10
Proximal	19	2-5 cm	46	Flat	35	Absent	72
Medial	4	>5 cm	5	Round	37	No observation	18
Distal	14			No observation	18		
		Scar count				**Directions count**	
Cortex		Mean	= 1.33	**Remnant biface edge**		Mean	= 0.73
Present	0	Standard deviation	= 1.22	Present	3	Standard deviation	= 0.60
Absent	100			Absent	97		

Note: This table is based on a sample of 100 flakes

Crane Point site - Biface Reduction

Flake type		Size		Platform shape		Platform preparation	
Complete	9	<2 cm	6	Triangular	20	Present	28
Proximal	27	2-5 cm	44	Flat	6	Absent	7
Medial	6	>5 cm	0	Round	9	No observation	15
Distal	8			No observation	15		
		Scar count				**Directions count**	
Cortex		Mean	= 3.00	**Remnant biface edge**		Mean	= 2.00
Present	4	Standard deviation	= 0.34	Present	10	Standard deviation	= 0.57
Absent	46			Absent	40		

Note: This table is based on a sample of 100 flakes

TABLE 11

Comparison of Flake Attribute Analysis Data

Attribute	Variable	Brennan	44WR50	Crane Point
Flake type	Complete	33%	63%	18%
	Proximal	22	19	54
	Medial	22	4	12
	Distal	22	14	16
Cortex	Present	0	0	8
	Absent	100	100	92
Size	<2 cm	54	49	12
	2-5 cm	43	46	88
	>5 cm	3	5	0
Platform shape	Triangular	21	10	40
	Flat	14	35	12
	Round	19	37	18
	No observation	46	18	30
Remnant biface edge	Present	2	3	20
	Absent	98	97	80
Platform preparation	Present	6	10	54
	Absent	48	72	14
	No observation	46	18	30

TABLE 12

Difference-of-Proportion Tests for Flake Attribute Analysis

Variable	Fifty/ Crane Point	Fifty/ Brennan	Crane Point / Brennan
Flake type			
Complete	5.20	4.86	2.13
Proximal	4.38	0.50	4.58
Medial	1.85	4.09	1.65
Distal	0.32	1.75	1.01
Cortex			
Present/ Absent	2.86	0.00	4.03
Size			
< 2 cm	4.43	0.82	5.33
2-5 cm	4.95	0.58	5.76
> 5 cm	1.61	0.63	1.34
Platform shape			
Triangular	4.33	2.37	2.78
Flat	2.98	4.21	0.37
Round	2.38	3.39	0.16
Remnant biface edge			
Present/ Absent	3.48	0.25	4.66
Platform preparation			
Present	6.11	1.07	8.45
Absent	6.11	4.03	4.31

*Significant difference (= 0.05) = 1.96

TABLE 13

Difference-of-Means Tests for Flake Attribute Analysis

Attribute	Fifty/ Brennan	Crane Point / Brennan
Scar number	3.36	16.67
Test statistic	(p < .0027)	(p <.000001)
Scar direction	10.03	5.18
Test statistic	(p < .000001)	(p < .000001)

Comparisons of flake attributes among the three sites shows that differences exist (Table 11). To assess the statistical significance of the differences, a difference-of-proportion test (Parsons 1974:445-448) was applied to the percentage data, and a difference-of-means test (Parsons 1974:441-445) was applied to the data where means and standard deviations were available. Table 12 shows the results of the difference-of-proportion test between the Fifty and Crane Point Sites and the Brennan Site, and Table 13 shows the results of difference-of-means tests. A more detailed explanation of the methods used to analyze the debitage attributes is contained in Appendix I.

When flake types are considered, the percentages listed for complete flakes are significantly different among all three sites. The prevalence of complete flakes in the core-derived assemblage from the Fifty Site is consistent with earlier studies (Magne 1981; Gunn and Mahula 1977) which suggest that the emphasis on the flake as a product of core reduction, without the need to be concerned with biface reduction, produces fewer broken flakes. The percentage of complete flakes in the Brennan sample is significantly different from both of the other samples and indicates that a notable proportion of the flakes were core-derived while the majority resulted from the reduction of bifaces.

The proportion of cortex on the Brennan sample is similar to the Fifty Site sample, indicating that the Brennan flakes were derived from a primary lithic source, and that secondary sources played no significant role at the Brennan Site. In terms of size, the Brennan sample is again similar to the Fifty Site sample showing a large percentage of small flakes, as well as a significant percentage of medium size flakes.

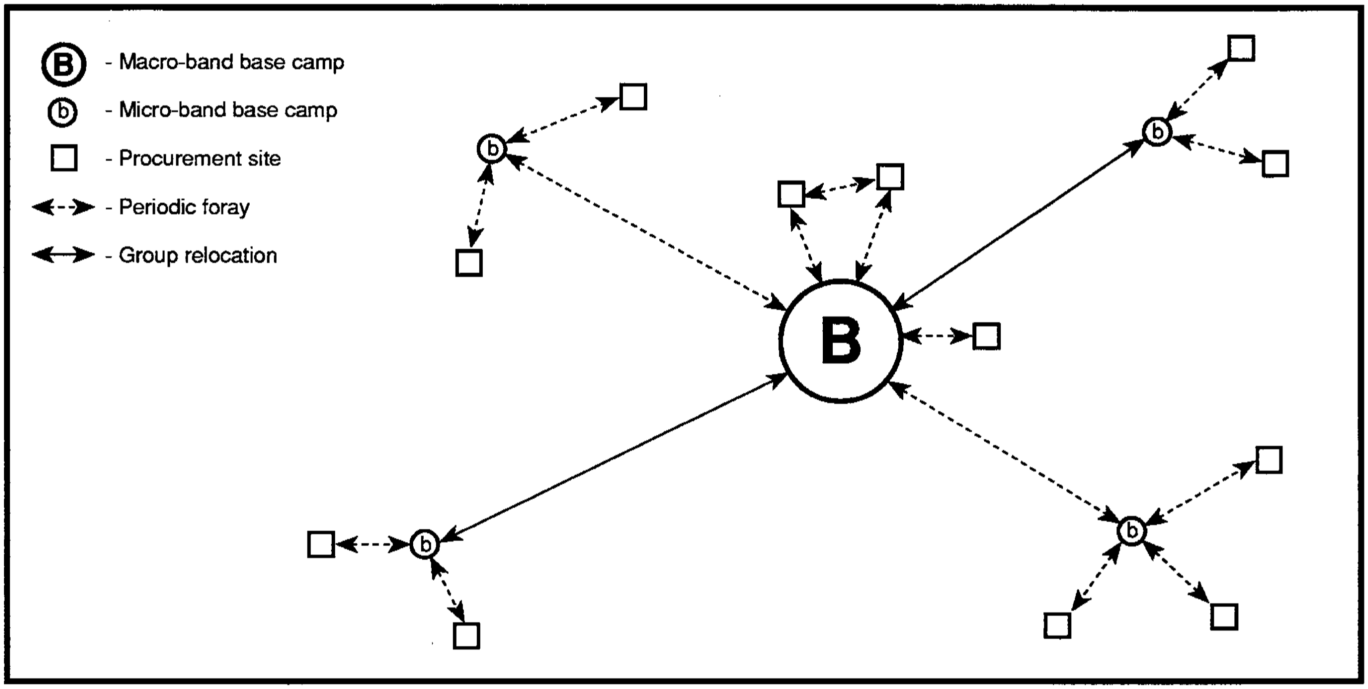
When striking platform shape is considered, the Brennan sample is more similar to the Crane Point sample, although there is a significant difference between the two samples for triangular shaped platforms. Triangular shaped platforms are associated with biface reduction (Appendix I). Percentages for the presence of remnant biface edge and platform preparation, which are associated with biface reduction, are quite low in the Brennan sample and are similar to those in the Fifty Site sample.

A difference-of-means test was conducted by Lowery and Custer (1990) on the sample flakes from the Fifty Site and the Crane Point Site. Results of the test showed that flakes from the Fifty Site have significantly fewer flake scars on their dorsal surfaces than those from Crane Point. Similarly, the flake scars on the dorsal surfaces of the flakes in the Fifty sample come from significantly fewer directions compared to the Crane Point sample. Therefore, scar complexity is more strongly indicative of biface reduction, while scar simplicity is more strongly indicative of core reduction. When difference-of-means were compared among the sites for flake scar attributes, the results indicated that there is a significant difference between both the Fifty and Crane Point Site samples and the Brennan sample. The results suggest that the biface reduction taking place at the Brennan Site was largely limited to the early stages of reduction which would not produce the degree of flake complexity resulting from later stages of biface reduction.

The results of the flake attribute comparisons indicate that the Brennan Site is generally more similar to the Fifty Site than the Crane Point Site. These findings are consistent with the Brennan Site's identification with quarry related activities of the Delaware Chalcedony Complex. However, the significantly lower percentage of complete flakes at the Brennan Site indicates that biface production played an important role in the organization of lithic technology at the site. This interpretation is further supported by the relatively high incidence of triangular shaped platforms on the debitage from the Brennan Site, which is known to be associated with biface technology. Therefore, the data indicates that the Brennan Site occupants were primarily relying on Delaware Chalcedony Complex cores for their lithic needs, but were nevertheless also

FIGURE 29

Woodland I Settlement Model



continuing to rely, to some extent, on transportable bifaces. The patterns of lithic resource use reflect the mobile life style of the Woodland I Period on the Delmarva Peninsula (Custer 1984, 1986, 1987, 1989; Custer and Bachman 1986).

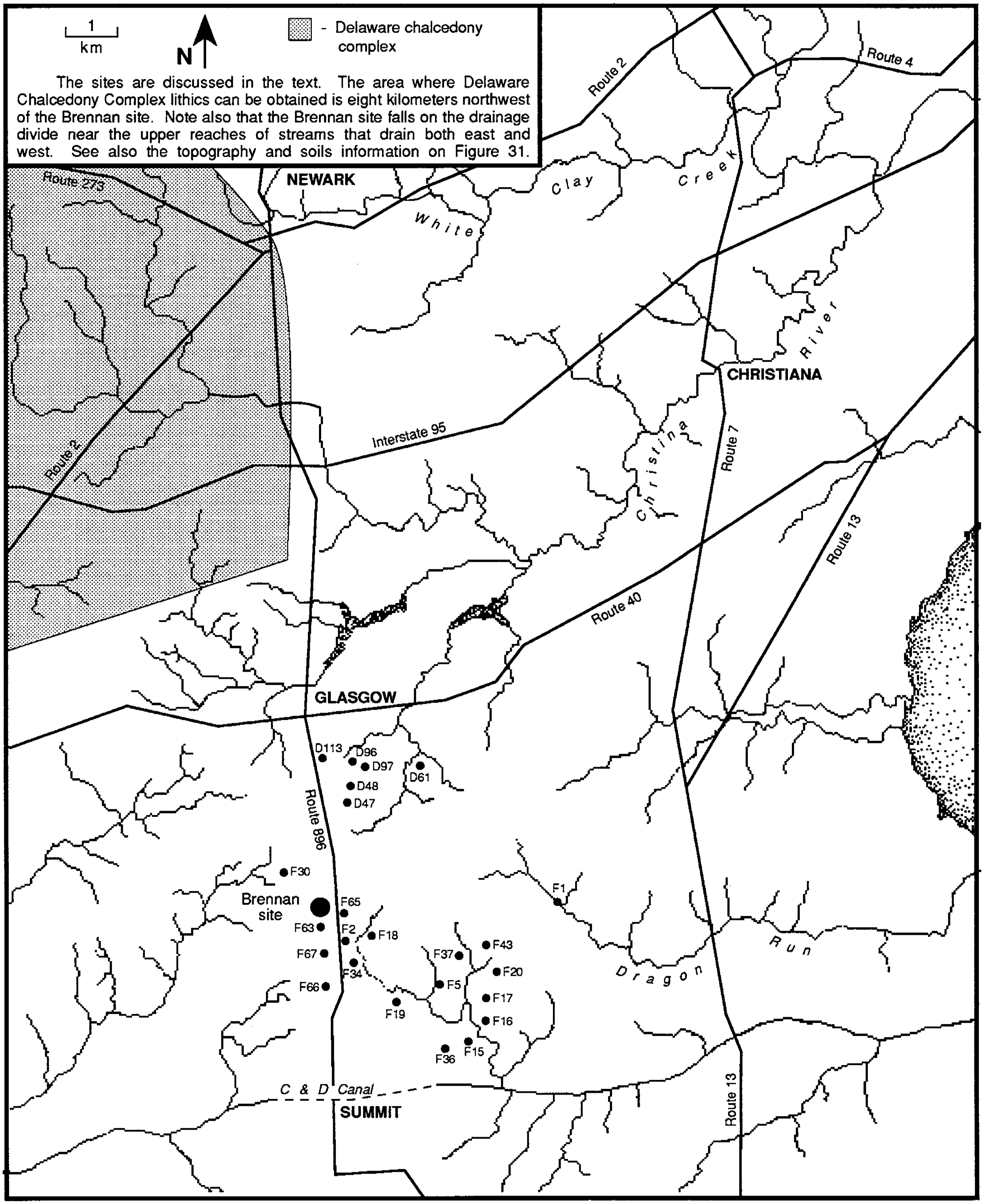
Regional Settlement Patterns

During the Woodland I Period on the Delmarva Peninsula Sites with reliable access to fresh water, such as on floodplains and near swamps/marshes, were preferred (Custer 1989:188). The number of macro-band base camps decreased relative to earlier periods although the size of base camps generally increased. The number of micro-band base camps increased and such camps were located close to special resource settings, such as rock outcrops and rich hunting and gathering locales. Procurement sites during the Woodland I Period were located in reference to these special resource settings (Custer 1986:106). Archaeological evidence from sites in northern Delaware (Thomas 1977, 1981; Custer 1982; Custer, Watson, and DeSantis 1986) indicate that settlement patterns in the Woodland I Period (Figure 29) were semi-sedentary and consisted of seasonal occupations of base camps with transient exploitation of nearby resource-rich locales (Custer 1984, 1986, 1989; Custer and Bachman 1984).

Several prehistoric sites are known from both uncontrolled and controlled surface collections and archaeological testing in the general area surrounding the Brennan Site (Figure 30). The data from most of the sites is insufficient to firmly assign functional classifications, although diagnostic artifacts collected from the sites indicate that many of them can be temporally

FIGURE 30

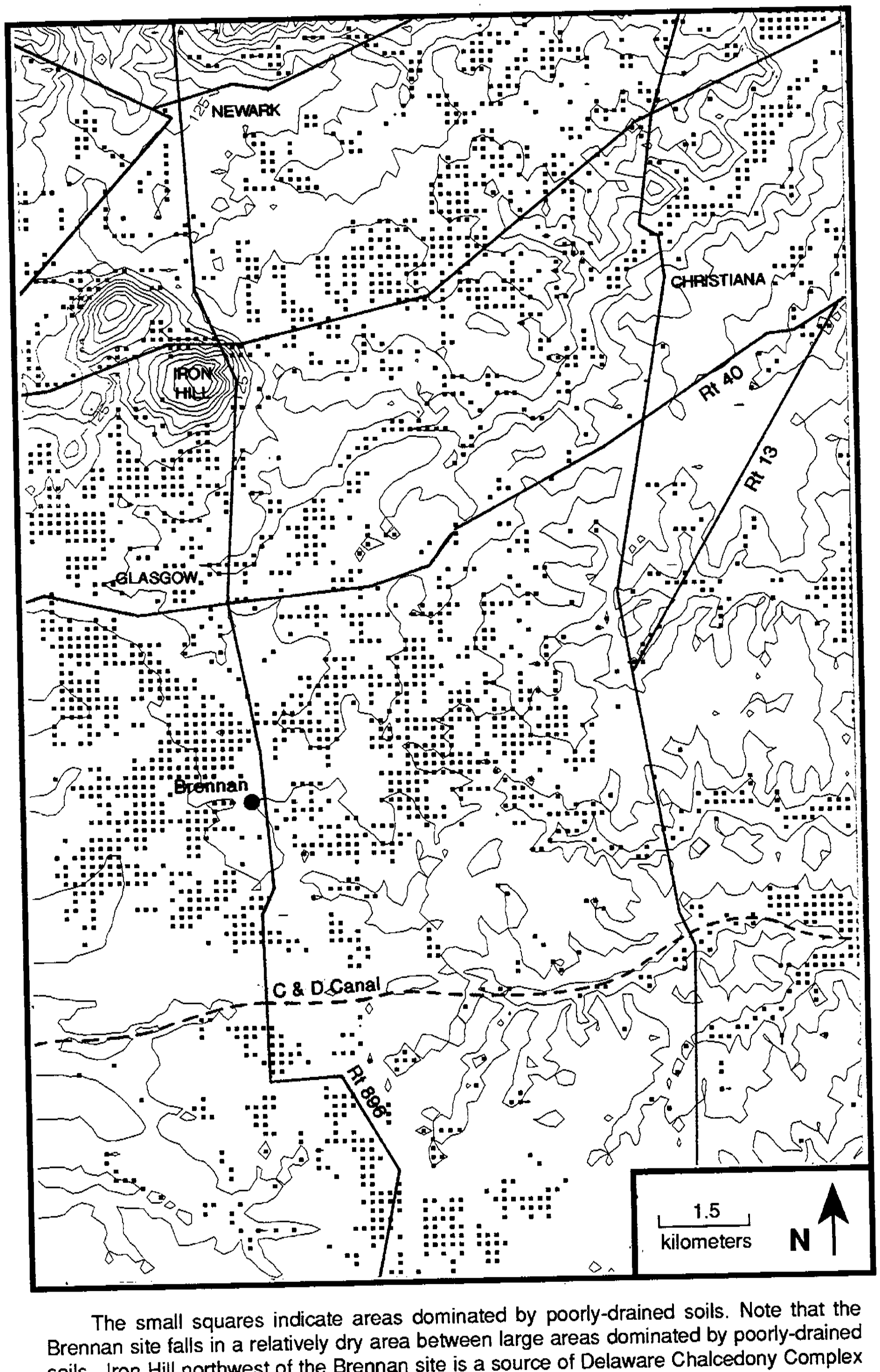
Locations of Other Prehistoric Sites in the Vicinity of the Brennan Site



The sites are discussed in the text. The area where Delaware Chalcedony Complex lithics can be obtained is eight kilometers northwest of the Brennan site. Note also that the Brennan site falls on the drainage divide near the upper reaches of streams that drain both east and west. See also the topography and soils information on Figure 31.

FIGURE 31

Location of the Brennan Site in Relation to Regional Landscape Features



The small squares indicate areas dominated by poorly-drained soils. Note that the Brennan site falls in a relatively dry area between large areas dominated by poorly-drained soils. Iron Hill northwest of the Brennan site is a source of Delaware Chalcedony Complex lithics. Contours are 25 feet. Based on data obtained from the New Castle County Department of Water Resources.

classified as Woodland I. The assemblages from two sites (7NC-F-2, 7NC-F-5) located relatively close to the Brennan Site and one site farther east (7NC-F-1) indicate the possibility that the sites may have been base camps. All were occupied during the Woodland I Period. Assemblages from other known sites in the area dating to the Woodland I Period (7NC-F-63, F-67, F-2, F-18, F-15, F-16, F-17, F-19, F-20, F-36, F-37) appear to indicate procurement functions.

The Brennan Site is situated in the Drainage Divide Zone of the High Coastal Plain on a well-drained slope in between poorly-drained terrain surrounding drainages to the northwest and southwest (Figure 31). The site is within 8 km of the lithic outcrops of the Delaware Chalcedony Complex at Iron and Chestnut hills. The site setting would have been appealing for procurement activities. Indeed, it appears from the presence of broken projectile points and numerous utilized flakes in the Brennan Site assemblage that some hunting and processing activities did take place at or near the site in addition to the reduction of primary jasper cores and bifaces. The reason, then, for the unusually distant location of the quarry reduction site may be that the occupants intended to engage in hunting activities, in addition to quarry activities, and proceeded to a known procurement locale closer to their base camp. The Brennan Site is one of the nearest locations south of Iron and Chestnut hills that provides the moist conditions necessary to attract game and to offer resources for gathering. The numbers of procurement sites in the general area testifies to the area's appeal.

Furthermore, the Brennan Site is located on a discontinuous ridge of well-drained soils that runs along the drainage divide of the Delmarva Peninsula in northern Delaware (Figure 30 and 31). The ridge may have served as a natural transportation route that avoids the mosaic of poorly-drained soils to the east and west of the ridge. Thus, the Brennan Site falls along a natural transportation corridor leading from the base of Iron Hill between the upper reaches of drainages that form Lums Pond and the St. Georges River on the east and Back Creek flowing into Chesapeake Bay on the west. The Chesapeake and Delaware Canal cuts through the ridge at Summit connecting the two drainage systems. Present Route 896 follows the ridge and has been a major transportation route north/south on the northern Delmarva Peninsula for almost 300 years. The people who used the Brennan Site probably camped for a short after visiting the quarries of the Delaware Chalcedony Complex at Iron and Chestnut hills where they procured raw materials with which to replenish their tool kits. At the Brennan Site they reduced the stone material some before continuing on their way to a base camp further south. The poorly-drained areas on either side of the ridge afforded good localities for hunting and gathering and it is evident the Brennan Site occupants engaged in some subsistence activities.

In conclusion, the excavations at the Brennan Site recovered significant information on the organization of lithic technologies outside of the immediate vicinity of the Delaware Chalcedony Complex quarries and on settlement patterns in Delaware's High Coastal Plain during the Woodland I Period. Further research at other sites in the local area may help to better define group territories, wandering ranges, and transportation routes.

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APPENDICES

APPENDIX I: METHODS OF FLAKE ATTRIBUTE ANALYSIS

The purpose of this appendix is to outline and describe the methods used to analyze the debitage from the Brennan Site and other archaeological sites discussed in this report. The methods are identical to the analyses performed on six archaeological sites in the State Route 1 Relief Corridor (Riley et al. 1994) and on the Paradise Lane Site (Riley, Custer, Hoseth, and Coleman 1994). The main goal of the analysis is to determine the source of the debitage, particularly to see if it was derived from bifaces or from cores. This appendix outlines the theoretical basis for studying the question of the bifacial or unifacial core origin of flakes; then, describes the flake attributes used to study the debitage. Finally, a series of base line studies of flakes of known bifacial or unifacial origin will be presented to show the validity of the research methods.

Theoretical Background

It is important to know whether debitage was derived from bifaces or from unifacial prepared, or amorphous, cores for a number of reasons. At the most basic level, organization of lithic technologies and patterns of lithic resource use are closely linked to settlement patterns and adaptations in various ways. Gardner's (1974, 1977, 1989, 1990) analyses of Paleo-Indian lithic technologies and lithic resource use were some of the first studies to be undertaken in the Middle Atlantic and recent studies have more closely analyzed the general trends noted by Gardner (e.g., Custer, Cavallo, and Stewart 1983; Stewart 1990). Other more generalized studies (e.g., Kuhn 1989; Bamforth 1986; Binford 1977; Bleed 1986; Goodyear 1979; Kelly 1988; Parry and Kelly 1987; Shott 1989; Torrence 1987; White and Modjeska 1978; Wiant and Hassen 1985; Magne 1985) have addressed similar issues.

Most studies have shown that factors such as settlement mobility, lithic resource availability, and the situational contingency of lithic tool use all play a role in determining how lithic technologies are organized, particularly the use of curated biface and prepared cores versus the expedient use of cores. For example, highly mobile groups who frequent areas where lithic resources are scarce use carefully curated stone tool kits consisting of bifaces and prepared cores. On the other hand, less mobile groups in areas of readily available lithic raw materials tend to make expedient use of quickly prepared amorphous cores. In some cases, a single group will alter its resource use based strictly on the availability of raw materials. For example, Paleo-Indian groups in the Shenandoah Valley of Virginia made and used carefully prepared tool kits based on bifaces and prepared cores when they were traveling away from the major quarry sources of jasper near the western margin of the Blue Ridge mountains (Gardner 1989; Verrey 1986). However, at hunting and processing sites close to the quarry sites, they used a variety of amorphous cores (Carr 1986). In sum, it can be very useful to know whether an assemblage of debitage was derived from bifaces or cores.

When considering the lithic technologies of prehistoric groups of the Delmarva Peninsula, it should be noted that numerous studies of lithic technologies have shown that there is a large amount of variability in the use of bifaces or unifacial cores, as portable tool kits. For example, a detailed analysis of late Paleo-Indian/Early Archaic tool kits from central Eastern Shore of Maryland (Lowery and Custer 1990) has shown that these early groups made extensive use of bifaces as the central element of their transported tool kit during part of their journeys across the landscapes of the Delmarva Peninsula, where lithic resources were at a premium. The use of bifaces may be one reason for a focused use of cryptocrystalline materials (Goodyear 1979; Custer 1989:119). However, when their transported, or curated (Binford 1979) tool kits were depleted, they seem to have focused more on unifacial cores (Lowery 1989) procured and produced on an expedient, or as-needed basis. In contrast, numerous studies of lithic technologies of later groups (e.g., Custer and Bachman 1986; Custer 1987; Custer, Watson, Hoseth, and Coleman 1988) indicate that there was a greater emphasis on cores, rather than bifaces, as sources of flakes in transported and curated tool kits during the Woodland I Period when people were more sedentary.

Studies of lithic technologies of northern Delaware, in the vicinity of the Brennan Site, have shown other sources of variability in the composition of stone tool kits and patterns of lithic resource use. Cobble beds are quite numerous along the Fall Line and the adjacent areas of the High Coastal Plain and such places are important sources of secondary raw materials which are suitable for the manufacture of stone tools (Custer and Galasso 1980). At the same time, high quality, primary cryptocrystalline lithic resources are available from the Delaware Chalcedony Complex (Custer, Ward, and Watson 1986) which is located just south of the Fall Line in western New Castle County, Delaware, and eastern Cecil County, Maryland. All of these sources of lithic raw materials were used by the prehistoric inhabitants of northern Delaware and the varieties of uses seem to be greatest during the Woodland I Period. Some groups made use of secondary cobble resources for both bifaces and cores, although cobble resources seem to be more commonly used for cores (e.g., Custer 1987; Custer and Bachman 1986; Custer, Sprinkle, Flora, and Stiner 1981). On the other hand, some groups transported large cores of cryptocrystalline jasper and used them as a source for flake tools (e.g., Custer, Watson, Hoseth, and Coleman 1988).

Because the tools and debitage deposited at a site by its prehistoric inhabitants reflect the lithic materials which they had with them, or could obtain locally at the site, and because curated lithic materials reflect immediately prior visits to quarry sites or other lithic source locations, we can understand prehistoric groups movement patterns by comparing the range of lithic resources used at a site with the locally available materials. Furthermore, if we can determine whether the flakes were derived from bifaces, prepared cores, or amorphous expediently-manufactured cores, we can understand how prehistoric groups were transporting and using lithic resources.

Prior research (Watson and Custer 1990) has shown that there are important regional differences in lithic transport and use in the central Middle Atlantic region that can reveal much about prehistoric movements, settlement mobility, and patterns of organization of lithic technologies. In the central and southern New Jersey Coastal Plain and the central Delaware region, particularly the St. Jones and Murderkill drainages, lithic resource use during early Woodland I times seems to be focused on argillite and rhyolite for bifaces and cryptocrystalline cobble cores for flake tools. In contrast, contemporary groups of the Fall Line Zone and High Coastal Plain of Delaware have a very different and highly variable technological organization based on a use of primary jasper and cherts for both large cores and bifaces, cobble resources for both cores and bifaces, and some ironstone, argillite, and rhyolite for bifaces. The lithic resource patterns are so very different that they might be indicators of different cultural groups using different territories, or they might be indicative of the wide variability of lithic resource use within a single social group. Application of the research methods described in this appendix will help us to better understand how prehistoric groups were using different lithic resources at different locations across the landscape.

Flake Attributes

The attributes used in this analysis were selected from a variety of debitage attributes described in the work of Verrey (1986), Magne (1981, 1985), and Gunn and Mahula (1977), and are listed below:

1) Flake Type (complete, proximal, medial, or distal) (Figure 32). This variable measures the degree of breakage of the flake assemblage and is useful because biface reduction tends to produce more broken flakes than does production of flakes from cores. Biface reduction produces more broken flakes because during biface reduction the emphasis is on effectively reducing the thickness of the biface (Callahan 1979) and the production of flakes takes on a secondary role. In contrast, core reduction emphasizes the flake itself resulting in fewer broken flakes.

2) Presence or Absence of Cortex. This attribute helps to determine if the flake was derived from a primary or secondary raw material source.

3)Flake Size (<2cm, >2cm-<5cm, >5cm)
(<10mm, >10mm-<15mm, >15mm-<20mm, >20mm-<25mm, >25mm-<30mm, >30mm-<35mm, >35mm-<40mm, >40mm-<45mm, >45mm)

4) Number of Flake Scars on the Flake's Distal Surface. This variable was recorded because flakes produced from biface reduction tend to have more remnant flake scars on their dorsal surface, due to earlier episodes of bifacial reduction, than do flakes derived from cores.

5) Number of Directions from which the Flake Scars Were Struck. This variable also identifies flakes produced from bifacial reduction, as opposed to cores, because flakes from bifacial reduction will show a greater number of flake directions on their dorsal surfaces due to earlier episodes of biface reduction.

6) Shape of the Flake Platform (flat, round, triangular) (Plate 4). Gunn and Mahula (1977) note that flat platforms are typical of flakes struck from cores, triangular platforms are typical of biface thinning flakes, and round platforms are typical of early stage biface reduction flakes and decortication flakes.

FIGURE 32

Flake Types

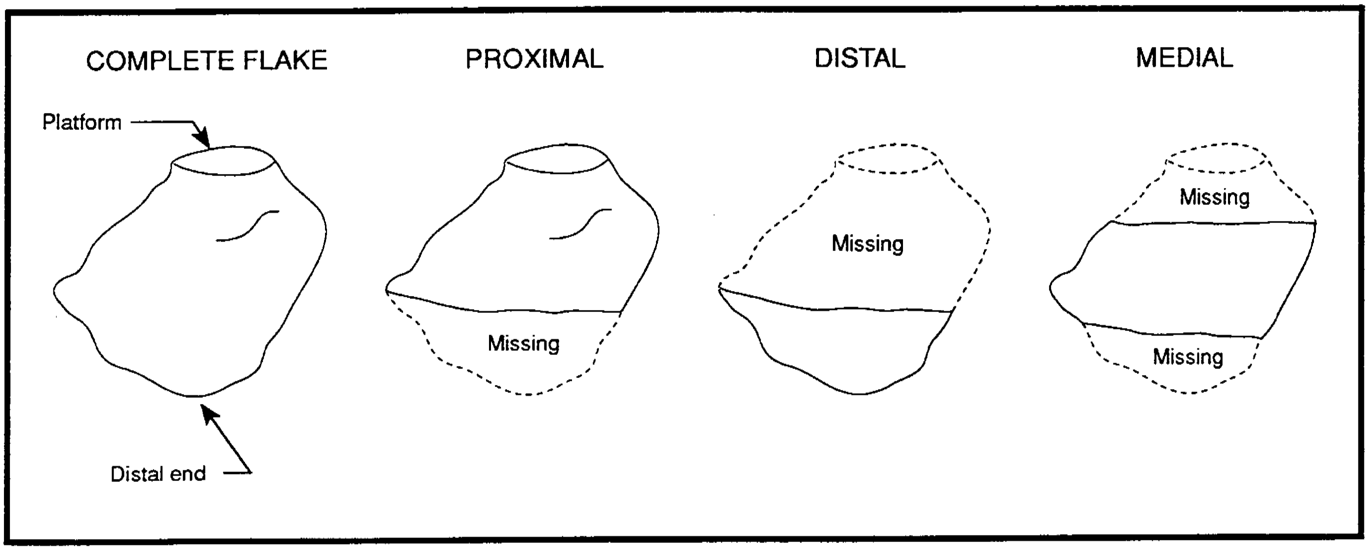


Plate 4

Flake Platform Shapes

Plate 5

Biface Production Stages

A: Early Stage B: Middle Stage C: Late Stage

7) Presence or Absence of Remnant Biface Edges. This attribute is the best sign that a flake was derived from a biface rather than a core.

8) Presence or Absence of Retouch. This variable simply records whether or not the flake was retouched to have a particular edge shape.

TABLE 14

Distributions of Flake Attributes

Distribution	Callahan early stage biface No.	%	Callahan late stage biface 1 No.	%	Callahan late stage biface 2 No.	%	All late stage bifaces No.	%	All bifaces No.	%	44WR50 core No.	%
Flake type												
Complete	30	(11)	6	(4)	21	(18)	27	(11)	60	(12)	63	(63)
Proximal	51	(19)	52	(38)	44	(38)	96	(38)	147	(28)	19	(19)
Medial	76	(29)	37	(27)	20	(17)	57	(22)	133	(25)	4	(4)
Distal	106	(40)	43	(31)	32	(27)	75	(29)	181	(35)	14	(14)
Cortex												
Yes	162	(61)	4	(3)	0	(0)	4	(2)	166	(32)	0	(0)
No	104	(39)	134	(97)	117	(100)	251	(98)	355	(68)	100	(100)
Size												
Large	11	(4)	1	(1)	1	(1)	2	(1)	13	(2)	5	(5)
Medium	66	(25)	25	(18)	16	(14)	41	(16)	107	(20)	46	(46)
Small	189	(71)	112	(81)	100	(85)	212	(83)	401	(78)	49	(49)
Scar count												
Mean	1.81		2.25		2.13		2.19		2.00		1.33	
Standard deviation	1.01		0.82		0.86		0.84		0.95		1.22	
Directions												
Mean	10.52		2.06		1.80		1.94		1.73		0.73	
Standard deviation	0.81		0.66		0.25		0.69		0.78		0.60	
Platform shape												
Triangular	58	(67)	50	(91)	60	(91)	110	(91)	168	(81)	10	(10)
Round	8	(9)	5	(9)	3	(5)	8	(6)	16	(7)	37	(37)
Flat	20	(23)	0	(0)	3	(5)	3	(3)	23	(12)	35	(35)
Biface edge												
Yes	12	(13)	17	(31)	11	(17)	28	(23)	40	(19)	3	(3)
No	77	(87)	38	(69)	55	(83)	93	(77)	170	(81)	97	(97)
Platform preparation												
Yes	74	(90)	55	(98)	54	(82)	109	(77)	183	(88)	10	(10)
No	12	(10)	1	(2)	12	(18)	13	(23)	25	(12)	72	(72)
Number	268		141		119		260		528		100	

Control Analyses

The attributes listed above have been used to discriminate between flakes derived from bifaces and flakes removed from cores in the studies noted above especially Gunn and Mahula (1975) and Magne (1981, 1985). Nonetheless, in order to test their usefulness, a series of control studies was undertaken using debitage from experimental reproductions of bifacial tools and debitage from archaeological contexts where refitting analyses confirmed the origin of flakes

TABLE 15

Test Statistics for Flake Attribute Comparisons

	LS1/ LS2	E/ LS1	E/ LS2	E/ Late	44WR50 /E	44WR50 /L
Flake type						
Complete	3.52*	2.34*	1.73	0.29	10.06*	10.21*
Proximal	0.01	3.98*	3.79*	4.61*	0.08	3.37*
Medial	1.86	0.44	2.44*	1.70	5.11*	4.12*
distal	0.67	1.80	2.42*	2.59*	4.76*	3.01*
Size						
Large	0.11	1.91	1.69	2.45*	0.34	2.56*
Medium	0.96	1.52	2.45*	2.46*	3.85*	5.89*
Small	0.92	2.21*	3.02*	3.27*	3.94*	6.55*
Scar count						
Mean	1.14	4.75	3.19*	4.69*	3.511*	6.49*
Standard deviation	---	---	---	---	---	---
Directions						
Mean	4.32*	7.26*	5.13*	6.41*	10.16*	16.42*
Standar diviation	---	---	---	---	---	---
Platform shape						
Triangular	0.00	3.21*	3.44*	4.25*	8.11*	12.01*
Round	1.00	0.04	1.12	0.71*	4.14*	5.31*
Flat	1.60	3.86*	3.19*	4.69*	2.02*	6.63*
Biface edge						
Yes	1.85	2.53*	0.55	1.76	2.66*	2.57*
No	1.85	2.53*	0.55	1.76	2.66*	2.57*
Platform preparation						
Yes	2.92*	2.45*	0.71	0.72	10.39*	11.79*
No	2.92*	2.45*	0.71	0.72	10.39*	11.79*

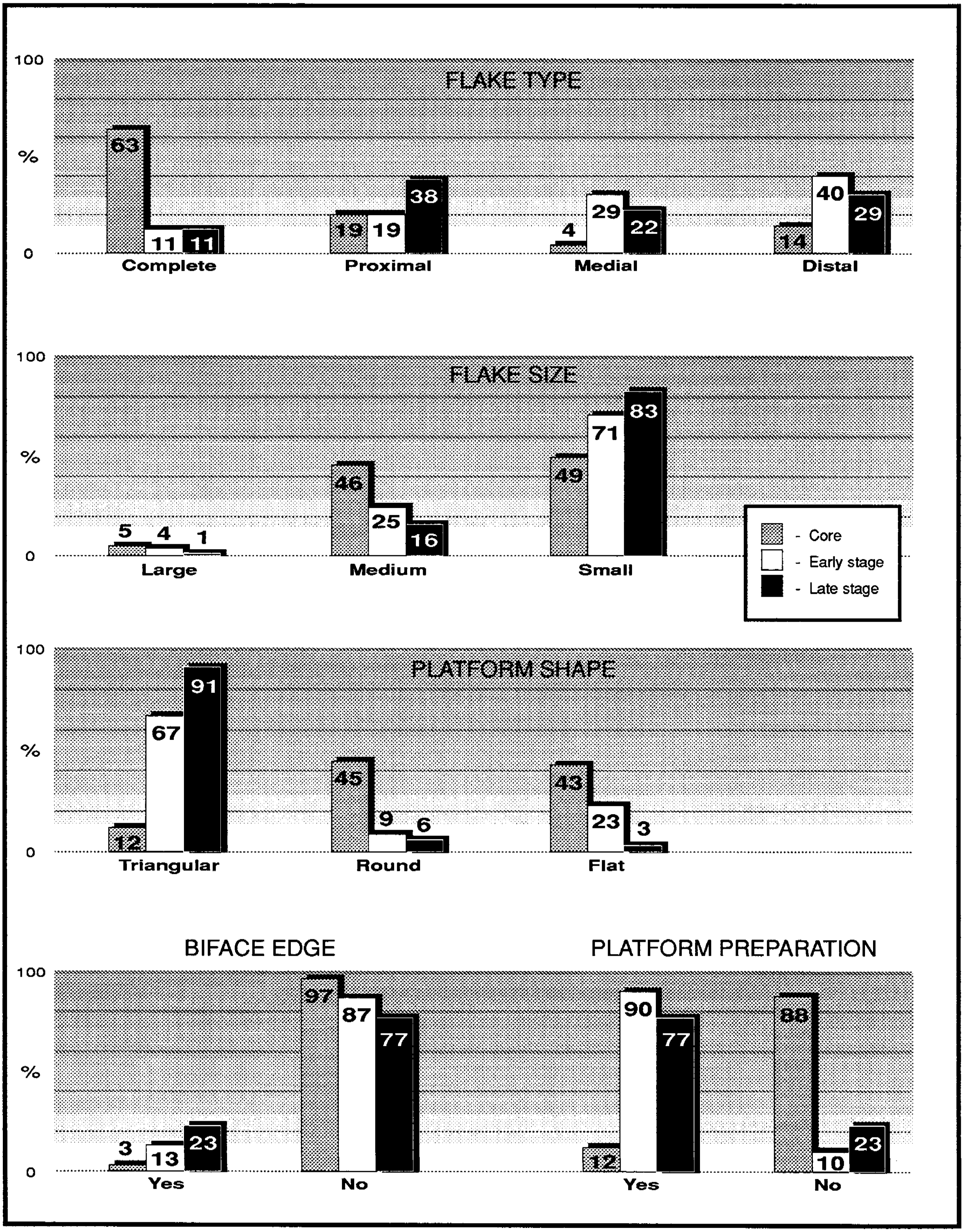
* = statistically significant difference

from either cores or bifaces. The first set of control debitage is a random sample of 100 flakes from the Fifty Site, a stratified Paleo-Indian/Early Archaic site from the Shenandoah Valley of Virginia. Refitting of the debitage (Carr 1986) from the site has shown that the flakes are primarily derived from the reduction of amorphous and blocky cores of jasper. The remaining control samples of debitage were derived from the manufacture of three bifaces by Errett Callahan (Plate 5). One biface is an early stage biface and the other two are middle to late stage bifaces (see Callahan 1979 for a description of the stages). All of the debitage from the bifaces was saved by stage so that the samples could be divided into early and late stage debitage.

Table 14 shows the distribution of the flake attributes for each of the bifaces, the late stage biface samples combined all bifaces combined, and the core debitage from the Fifty Site. Table 15 shows the values of the test statistics for a series of comparisons of the debitage samples using difference-of-proportion and difference-of-mean tests (Parsons 1974). The first set of test statistics shows a comparison of the debitage samples from the two late stage bifaces. Some

FIGURE 33

Comparison of Flake Attributes for Stages of Biface Production



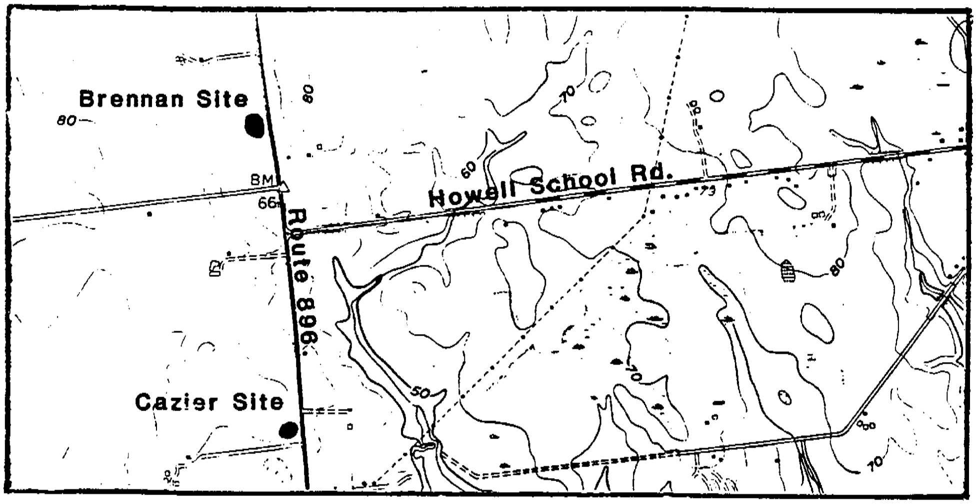
differences are noted with one of the debitage assemblages showing significantly more complete flakes, more examples of platform preparation, and more complex patterns of flake scars on the distal flake surfaces. However, the second two comparisons noted in Table 15 show that both late stage biface debitage assemblages are significantly different from the early stage biface. In general, there are significantly more complete flakes in the early stage assemblages, more small flakes in the later stage assemblages, more flake scars in more complex patterns among the late stage assemblages, and more triangular shaped platforms among the late stage assemblages. Because the late stage biface debitage assemblages were more like each other than they were like the early stage assemblage, the two samples were combined for analysis. A comparison of the early stage assemblage and the combined late stage sample is also noted in Table 15 and the results of comparison show the same pattern of significant differences above.

Figure 33 shows a comparison of the debitage assemblages from the core, the early stage biface, and the late stage bifaces. Test statistics from these comparisons are also noted in Table 15B. The main difference between the biface and core flake types is the presence of significantly more complete flakes in the core assemblage. Significant differences are also noted in flake size with more smaller flakes present in the biface assemblages. Likewise, triangular-shaped platforms are significantly more common among the biface assemblages. Remnant biface edges are significantly more common among biface assemblages, as expected, and platform preparation is significantly more common among the biface assemblages as well.

In general, the comparison of the control assemblages confirms the results of prior studies (Magne 1981, 1985; Gunn and Mahula 1977). For the most part, a debitage assemblage from biface reduction is characterized by low proportions of complete flakes, large proportions of small flakes, large proportions of flakes with triangular platforms, large proportions of remnant biface edges, and many instances of platform preparation. In contrast, core reduction debitage assemblages have large proportions of complete flakes, and few instances of triangular platforms, remnant biface edges, and platform preparation.

APPENDIX II: Public Information Handout

jasper point preform



jasper uniface

BRENNAN PREHISTORIC ARCHAEOLOGICAL SITE

A prehistoric cultural resource mitigation program is being conducted by the Delaware Department of Transportation, Division of Highways, and the Federal Highway Administration in conjunction with the University of Delaware Center for Archaeological Research, at the Brennan Prehistoric Archaeological Site (7NC-F-61A). The mitigation is necessitated by the proposed widening and dualization of Delaware Route 896 between Route 4 - West Chestnut Hill Road and the Summit Bridge approach.

The Brennan Site was first located during an earlier cultural resource reconnaissance of the Route 896 Project Area. The site has been identified as a specialized stone tool manufacturing area, where fragments of cryptocrystalline rock known as "jasper" were manufactured into various forms of stone tools. The source of this stone is the Delaware Chalcedony Complex, including Iron and Chestnut Hills, located five miles to the north. Artifacts recovered from the site consist primarily of flakes of jasper which are the by-products of stone tool manufacturing activities. The site has also yielded projectile points diagnostic of the Woodland I cultural period, which lasted from approximately 3000 B. C. to A. D. 1000.

The Brennan prehistoric site is significant for two reasons. First, it constitutes an opportunity to study the procurement and processing of Delaware Chalcedony Complex jasper. Although other prehistoric sites have been investigated in the Iron and Chestnut Hill Areas, the Brennan Site is located much farther away from the prehistoric quarries than are other sites with a similar level of jasper reduction. Second, the site contains artifacts which are buried below plow-disturbed soils, a phenomenon rarely encountered in this vicinity. These artifacts are at or near the original place they were deposited, and as such afford the opportunity to study prehistoric behavior as reflected in patterned artifact distributions.

If you request any further information or particulars concerning this cultural resource project, please contact the site supervisor, Scott Watson, at 451-6590, or Kevin Cunningham, DelDOT Archaeologist at 736-4644.

APPENDIX III: GLOSSARY

Aboriginal - Prehistoric peoples in North America.

Aeolian - Carried by the wind. For example, sand dunes are aeolian deposits.

Ap-B-C profile - A standard coding sequence for soil development. The Ap horizon is the plow zone; the B horizon is a zone leached by ground water; and the C horizon is the parent material on which the soil has developed.

B1t horizon - The first B soil horizon below the A horizon. There may be several B horizon characterized by different sediments, color, or degree of weathering or illuviation.

Archaeology - The study of the people of the past through the recovery and analysis of the artifacts and other material left behind and context of the finds.

Argillic horizon - A B soil horizon in which argillite minerals have accumulated due to illuviation.

Artifact - Any object shaped or modified by humans, or as a result of human activity.

Assemblage - The contemporaneous objects and associations found at an archaeological site.

Band-level organization - Small, confederations of family groups who subsist by hunting and gathering. Bands do not usually have a formal political organization, and their composition is often fluid, or seasonal.

Base camp - A prehistoric, hunter-gatherer dwelling site from which resource procurement forays are made.

Bedload - The material carried in the bed of a stream - usually larger material, such as sand, gravel, and cobbles - that rolls, tumbles, or bounces along.

Biface - A stone tool that has been flaked on both sides.

Boreal - Northern forests and tundra.

C horizon - The parent material (sediment) on which a soil has developed.

Chalcedony - Cryptocrystalline quartz or chert; for example, agate.

Cobble - A water-worn, or rounded stone, frequently used as raw material for stone tool manufacture by prehistoric people.

Colluvium - A loose deposit of rock or soil debris accumulated at the base of a cliff or slope.

Core - A piece of stone from which other pieces of stone are flaked off to make artifacts.

Cortex -The weathered exterior of a piece of lithic material, may be either vein or water-worn cortex.

Cretaceous Geologic period - The third period of the Mesozoic era characterized by the development of flowering plants and the disappearance of dinosaurs.

Cryptocrystalline - Indistinctly crystalline; having an indistinguishable crystalline structure (e.g., chert and jasper).

Culture - The non-biological mechanism of human adaptation, and rules, traditions, and customs of a particular society.

Curated technology - Artifacts reused and transported so often that they are rarely deposited in contexts which reflect their actual manufacture and use.

Datum - A fixed point from which all levels are measured at an archaeological excavation. A datum line is a horizontal reference line for making scaled drawings of excavations.

Debitage - Waste material from the manufacture of stone tools.

Deciduous - Leaf-bearing trees that shed in autumn.

Diagnostic - Artifacts with traits that are distinctive of a particular time period.

Difference-of-proportion test - A statistical test that measures the degree of difference between samples from two different populations of things.

Difference-of-means test - A statistical test that determines if the means (averages) of variables, or measurements are different.

Discards - Stone tools that are too heavily resharpened and modified to be further used.

Distal end - The pointed end of a projectile point.

Early stage biface discard - A biface that was used in an early stage of manufacture and then discarded before being more finely finished.

Early stage biface reject - A biface that never passed beyond the initial steps of stone tool production due either to flaws in the raw material or manufacturing errors.

APPENDIX III: Glossary (continued)

Edaphic factors - Environmental factors due to the physical, chemical, and biological characteristics of the soil.

Estuary - A semi-enclosed body of water where fresh and salt water mix due to the action of currents and tides.

Extant - Still in existence.

Facie - A stratigraphic body distinguished from others by appearance, composition, or mode of deposition.

Feature - Any soil disturbance or discoloration that reflects human activity or an artifact that is too large remove from an archaeological site; for example, a house, storage pits, or fire place. A feature may also be a very dense cluster of artifacts; for example, a lithic chipping feature.

Fire-cracked Rock - A rock that has fractured and/or discolored due to exposure to heat.

Flake - A piece of waste material produced during the manufacture of stone tools.

Flotation - The use of fluid suspension to recover tiny plant and bone fragments from archaeological deposits, such as feature fill.

Fluvial - Produced by the action of flowing water.

Formation - A distinctive unit of rock or sediment, often named by the geologist that first describes it, e.g., the Columbia Formation.

Gabbro - Coarse-grained, dark igneous (volcanic) rock.

Glacial outwash - Material carried away from the foot of a melting glacier by running water. Glacial outwash streams are commonly very dirty, and result in extensive deposits of gravel, sand, silt, and clay.

Gneiss - A coarse-grained rock with alternating bands of coarse and more fine-grained material.

Ground stone tool - A tool that has been shaped by grinding or pecking.

Hammerstone - A rounded stone to be used as a hammer. Sometimes grooved for hafting to a handle. Usually ungrooved, however, it has a variety of forms ranging from a crudely shaped sphere to a finely ground ovoid with a battered end.

Holocene - The latest division of the Quarternary period, which started 10,000 B.P.

APPENDIX III: Glossary (continued)

Illuviation - The movement of colloids, soluble salts, and mineral particles (clay) down through a soil profile through the leaching action of water.

Inclusions - Mineral, crystalline, or other material that is included within a larger, more uniform rock matrix.

Incipient ranked society - A society with a political organization in which some people have higher status than others, but no real extra, or formal power.

Jasper - Impure, slightly translucent cryptocrystalline quartz. Often red, brown, or green in color.

Jasperoid - Cryptocrystalline rock formed by the replacement of some other material in a larger rock body.

Late stage biface reject - A biface which was either broken during the later stages of manufacture, or which had been reduced improperly, so that further reduction would not produce a usable tool.

Lateritic - A soil zone leached of silica with concentrations of iron and aluminum hydroxides.

Lithic - Pertaining to or consisting of stone.

Loam - A loose soil composed of roughly equal parts of silt, clay, and sand, often containing organic matter, as well. Usually very fertility and conducive to plant growth.

Locus - A defined archaeological site or testing location.

Macro-band base camp - For a hunter-gatherer society, an archaeological site one hectare or larger in area characterized by a wide variety of tool types, abundant ceramics, semi-subterranean house structures, storage pit features, and abundant debitage from tool manufacture and reduction.

Mesic forest - A forest of relatively, wet-adapted plant species, such as hemlock forests.

Micro-band - A component of macro-band, perhaps one or two extended families, that periodically operates independently of the macro-band group.

Micro-flake - A lithic flake small than 1/4 inch. Usually recovered only from flotation samples which are passed through very fine screens.

Migmatite - Rock consisting of thin, alternating layers and lenses of granite and schist.

Norite - A variety of gabbro.

Pedestrian survey - The walking and collecting of an archaeological site without the excavation of subsurface units.

Pedogenic - Referring to the development of soils in place.

Physiographic zone - Regions or areas that are characterized by a particular geography, geology, and topography.

Piedmont region - An area of gently rolling to hilly land lying between the Appalachian Mountains and the Atlantic Coastal Plain. The division between the Piedmont region and the Coastal Plain is marked by the Fall Line.

Platform - See striking platform.

Pleistocene - A division of the Quarternary Period, which began around 2 million years ago and characterized by rapid hominid evolution from Australopithecinae to Homo sapiens sapiens. Also characterized by the Ice Ages.

Plow zone - In a plowed field, the upper layer of organic soil which is continually reworked by plowing. In the Middle Atlantic region, plow zones are about 8-12 inches thick.

Prehistoric - The time period before the appearance of written records. In the New World this generally refers to indigenous, non-European societies.

Primary lithic resource - Outcrops of workable stone that are found within the matrix of their original formation.

Procurement Site - A place that is visited because there is a particular item to acquire in the vicinity; i.e., lithic outcrops.

Projectile point - Strictly speaking, a biface attached to the head of an airborne item of weaponry, like an arrow or a thrown dart. In general usage, refers to any biface.

Provenience - The exact location where an artifact was found on an archaeological site.

Pyroxenite - A medium or coarse-grained rock consisting of pyroxene minerals.

Quarry site - An archaeological site located at either a primary or secondary outcrop of lithic material used in the manufacture of stone tools.

APPENDIX III: Glossary (continued)

Quarry reduction station - A place where material obtained from a quarry, such as large flakes, cores and very early stage bifaces were taken for further reduction into smaller primary-thinned bifaces.

Regolith - Weathered, broken up bedrock. Often in a transition zone between C soil horizons and solid bedrock.

Rejects - Stone tools which have been thrown away due to manufacturing or material flaws.

Schist - A medium or coarse-grained metamorphic rock made up of micaceous minerals.

Secondary lithic resource - Cobbles and boulders of variable size that have been removed from the matrix of their original formation, transported by alluvial or glacial agents, and redeposited at a new location which may be quite distant from their original source.

Sediment - Particles of rock and mineral material laid down through the action of wind and water.

Siliceous - Composed, or formed primarily of silica.

Site - A place with evidence of human occupation.

Soil horizon - Soils are classified into three (A, B, and C) horizons, due to different kinds of chemical and physical processes.

Spokeshave - A stone tool with a semicircular concavity used for smoothing spears or arrowshafts.

Staging site - A temporary camp where preparations are made for another operation, such as a hunting foray.

Stemmed point - A projectile point that has an obvious hafting element for attachment to a shaft.

Stratigraphy - The soil and sediment layering on an archaeological site; the characteristics of each individual stratum and its relationship to others in the sequence is critical to understanding the temporal and spatial characteristics of the site.

Strata - The various layers of soils or sediments of human or geological origin which comprise archaeological sites.

Striking platform - On a flake - the remnant edge of the surface that was struck when the flake was removed from a larger body of rock.

APPENDIX III: Glossary (continued)

Subsoil - Sterile, naturally occurring soils, or sediments, not changed by human occupation.

Surface collection - Collecting artifacts seen on the surface of the ground, such as in an open or plowed field.

Susquehannock Indians - Iroquoian people living along the lower reaches of the Susquehanna River during the Woodland II and Contact periods.

Thermally altered - Changed in some way by exposure to high temperatures. The flaking characteristics of some types of stone are improved by heat treating. Thermal alteration often results in reddening or other color changes in stone, and characteristic breakage.

Tool kit - A collection of artifacts interpreted as being designed for a specific task.

Topography - The surface physical features and configuration of land.

Uniface - A stone tool that has only been flaked on one side.

Unconformity - A surface of erosion or non-deposition that separates strata.

Utilized flake - A waste flake from stone tool manufacture used, without modification, as a tool for cutting or scraping. Utilization often damages the sharp edges of a flake.

Xeric forest - A forest characterized by plants adapted to dry conditions, such as grasslands and forests of oak and hickory.

Xerophyte - A plant that grows in arid conditions.